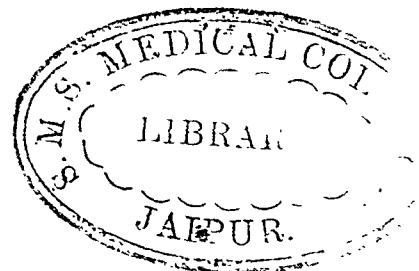# The American Journal of Surgery

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CONTENTS OF NEW SERIES, VOLUME LXI
ORIGINAL ARTICLES

Contents

Editorials

THE ART OF LOCAL ANESTHESIA

UPON two principles rests the science of surgery—the prevention of sepsis and the use of anesthesia. In the best utilization of both art as well as science is necessary. In the use of a local anesthesia art plays a particular part.

Regional block, infiltration or local anesthesia has many advantages over a general anesthetic. Safety, lowered toxicity and minimal shock follow its judicious employment and with greater experience its field can be broadened to include all types of operation. Yet, except by such masters as Farr and Labatt, its use is not general and in most instances is restricted to minor procedures or for use on moribund patients. This restriction in use is not due to technical errors in its administration, but results from both failure to understand the necessity for gentleness in operating and the importance of the psychic state of the individual patient. Unless one recognizes the importance of these factors in administering local anesthetic, failure will result no matter how skilled the application of the anesthetic. There are certain fundamental points that constantly must be kept in mind. The patient will be awake, apprehensive and aware of all words and actions of the operating team. The comfort and lack of pain of the remainder of the body must be observed. Cramped and uncomfortable positions must be avoided. Pressure from instruments or the assistant's

hands must be eliminated. As only the area directly infiltrated will be anesthetized, particular attention must be directed toward gentle handling of tissues. Rough retraction will cause pain beyond the numbed area. Tension on or torsion of organs innervated from beyond the anesthetic zone must be avoided. An entirely different technic, stressing gentleness, smaller and more delicate instruments, needles and sutures and, most important of all, the light hand, must be developed. This régime must be extended from the operator to every assistant or nurse. A general anesthetic frequently creates a false sense of security, even of obtuseness and roughness in the operating room. The fact that the patient is unconscious permits even levity at times and strict discipline frequently relaxes when the difficult technical part of the operation is completed. In the use of a local anesthetic no such situation can endure. Shop talk, rough, though surgical language increases the already high degree of apprehension and the banging and brandishing of instruments may play their part in destroying the co-operation of the patient, on which surgical success depends. Farr attributed a great deal of his outstanding success in performing all types of major operations under a local anesthetic to his "psycho anesthetist," a pleasant faced and voiced individual, who gained the patient's confidence before operation. She

accompanied and remained with the patient in the operating room and prepared him for any untoward reaction before it happened by carefully following the course of the procedure while maintaining her steady flow of conversation. The use of music, in which he pioneered, aided in the distraction. The radio today can play an even better rôle. Entire major procedures can be completed safely without the patient's knowledge with such skilled help. Anesthetists can well add this understanding background to their armamentarium. With local anesthesia this is an asset second only to surgical skill in the successful performance of the operation.

There is no limit to the possibilities of utilizing this anesthetic agent, as every type of surgery has been performed successfully on all parts of the body. In this field, as in many others, the machine trained surgeon who forgets that the "unfortunate victim" is a human being will run into difficulties. To the uninitiated a trial with local anesthesia is recommended. To those who are using it, an extension to other fields is suggested. To the military surgeon its use will not only facilitate the work, but where anesthetists are at a premium, valuable time may be saved. Shock, a major cause of military surgical failure, can be kept minimal by the liberal use of local anesthetic.

To the skilled surgeon adept with local anesthesia many technical aids will be found in the use of this anesthetic agent. For example, deep breathing by the patient at the surgeon's request will lift a deep lying gallbladder neck into the operative field. Voluntary holding of the breath will permit securing of an area difficult to expose. A cough at the command can identify the hernial sac close to the bladder. Dissection of many organs is facilitated by the line of demarkation developed by procaine saline infiltration. In such operations as appendectomy, thyroidectomy, many brain procedures, most rectal work and to a large extent, general abdominal surgery, local anesthesia will be the choice.

Certain technical points are suggested: (1) The aim of the anesthesia is not to hurt the patient. Gain his confidence and maintain it by notifying him beforehand of any new or possibly painful move. Do not have him so inebriated with sedatives that his reasoning power is lost. Have a skilled individual to talk to and guide and distract him during his anesthetic experience. The radio may play a stellar rôle at this stage. (2) Use dilute solutions inserted from one initial wheal. If necessary raise secondary wheals subcutaneously from the first point. (3) Keep the needle moving during the injection to minimize possible intravenous accidents. Guide the needle with the index finger to keep it superficial and in the correct area. (4) Frequently check by aspiration to avoid injecting into a major vessel. (5) Review before the operation the anatomy and especially the nerve supply of the operative area.

GERALD H. PRATT, M.D.

THE FOGGING OF SPECTACLES

IT is axiomatic that the nose as well as the mouth should be covered on all those who enter the operating room. Many wearers of spectacles find hot face masks cause a great deal of inconvenience, because of the readiness with which spectacles became fogged due to the condensation of moisture from expired air. For many years I have used a metallic stiffening in the mask over the nose which has helped tremendously. If it does not cause a dermatitis, adhesive tape as a shield along the top of the mask may be used. To prevent skin irritation, however, I have been wearing a strip of cellulose or scotch tape across the top of my mask which effectively fastens the mask to my face and nose, and prevents any of the expired air from reaching the glasses, thus preventing fog. Continued use of the cellulose tape causes no irritation of the skin. This has been found to be a most satisfactory answer to a very irritating problem.

GEORGE C. FOSTER, M.D.

Original Articles

PERINEPHRIC ABSCESS IN INFANTS AND CHILDREN*

A STUDY OF TWENTY-SIX PATIENTS SURGICALLY TREATED

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THE recognition that perinephric abscess is not a rare disease in infants and children is important if mistakes in treatment are to be avoided. Failure to consider the lesion as a possibility in diagnosis has occasionally accounted for unnecessary and harmful delay in instituting rational therapy on the part of pediatricians and physicians who are called upon to treat individuals in the younger age groups. Two aspects of the literature impress us as perhaps contributing to this occasional tendency to overlook the possibility of the lesion: first, the paucity of reports dealing with the disease in infants and children; and second, the erroneous conclusion occasionally derived in the study of published series that the disease is quite rare in children. These reports [1-5] are chiefly based on experience with adult patients in clinics engaged in treating older individuals. It is probable that a good many children in the communities in which these studies were made are cared for in hospitals specializing in children, and, thus, cases of perinephric abscess in children are not seen or included in the statistics of the adult institution.

That perinephric abscess is not a rarity in childhood may be seen from the collected series of Schatz[6] and of Greenwald and Kresky;[7] the former finds 174 cases reported in individuals under fifteen years previous to 1927, while the latter finds thirty-three additional cases appearing in the literature from 1927 to 1940. To emphasize this fact it seems worth while to present data on twenty-six proved and six possible cases seen in the last three decades at The Children's and Infants' Hospitals.

ANATOMICAL CONSIDERATIONS

A perinephric abscess is a suppurative inflammatory lesion occurring in the fibro-fatty bed surrounding the kidney within the sac formed by Gerota's fascia. An understanding of the anatomy of Gerota's fascia and of the changes in the character of the perinephrium during growth is of paramount clinical importance.

This fascia surrounds the kidney and a considerable amount of its fatty capsule in the form of a loose sheath, in which may be distinguished anterior and posterior walls, the whole forming a sac-like structure roughly the shape of an inverted pear. Laterally, the anterior and posterior walls of the sheath come into contact, fuse, and form a firm lateral wall to the perinephric space. Medially, they remain distinct, and the posterior wall fuses with the fascia covering the psoas and quadratus lumborum muscles, while the anterior wall is continued across the midline in front of the renal vessels and aorta to join the corresponding layer of the opposite side. The vertebral bodies and aorta, however, effectively close the gap medially between the walls and create a barrier to prevent suppuration within one perinephric space from extending to the opposite side. Thus,

spread of suppuration to the opposite side is virtually impossible and if bilateral perinephric abscesses are found, two different or separate sources must be sought.

frequently observed ("psoas spasm"), and why signs suggesting retrocecal appendicitis may occur (deep tenderness in the right lower quadrant, with or without a positive

Paranephric space
Perinephric space
Anterior sheath } of Gerota's
Posterior sheath } fascia
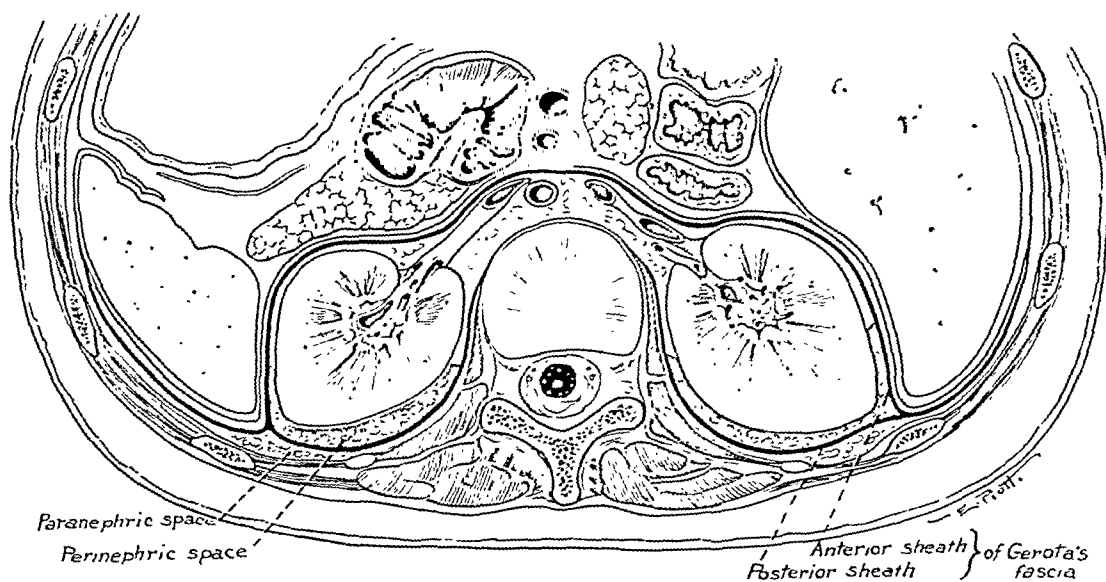
FIG. 1. Schematic drawing illustrating Gerota's fascia in horizontal section. (Gerota.)

Superiorly, above the level of the kidney and the suprarenal gland, the layers of Gerota's fascia unite and fuse with the fascia under the posterior diaphragm. Thus, while upward extension may occur, potentially threatening the subdiaphragmatic spaces, the infection must break through the fascial sheath and the posterior or diaphragmatic peritoneum if subdiaphragmatic abscess is to occur. In our experience,[8] this mechanism has never been the cause of a subdiaphragmatic space infection in children. (Fig. 1.)

Inferiorly, the layers are separately prolongated forming a tunnel-like extension of fascia downward around the ureter, ultimately to fuse with the lumbosacral fascial planes in the pelvis. There thus exists a natural path toward the pelvis for extension of perinephric inflammation, an event of frequent occurrence. This anatomical arrangement has been demonstrated radiographically by Rolnick,[9] and aids us to understand why pelvic extension of infection may commonly occur (thus causing certain radiographic phenomena), why signs of irritation of the psoas muscle are

"psoas sign," in a patient with the constitutional signs of infection). Anatomically, the rectrocecal abscess is anterior and lateral to the peri-ureteral extensions of Gerota's fascia, but because of the similarity in signs clinical distinction is often quite difficult. The term *paranephric* space has been used to describe this region in the lumbar gutter which is *outside* of Gerota's fascia.

In the newborn infant, the perinephric fat is sparse, and the space inside the sac formed by Gerota's fascia is relatively small. The increase in fibrous adipose tissue occurs, leaving the kidney encased in a thick sheath of fat. Thus, in a young child the perinephrium is relatively emptier than in an adult. This fact has been offered as an explanation of the alleged rarity of the lesion in children. This could be so only in those lesions in which infection is presumed to be seeded directly into the perinephrium from a distant focus. Obviously, the amount of perinephric fat can have little bearing on the incidence of infections seeded first in the kidney and then breaking into the space from the kidney, as this

would occur whether the surrounding fat were sparse or abundant. It is our belief that this latter is the usual if not invariable sequence.

INCIDENCE

All of our patients were under thirteen years of age. As can be seen in Figure 2, the distribution by age was relatively uniform throughout this period of life. This was true whether the lesion was metastatic or complicated underlying renal pathology. Our youngest patient was four months of age. (Fig. 2.)

In children, the difference in sex incidence does not appear to be quite as marked as is apparently true in adults in which males predominate in a ratio of about 3 to 1.[1] In our series, sixteen were males and ten were females, a ratio of about 3 to 2. The side involved seems to be of no significance, as thirteen of our patients had right lesions, and an equal number had left lesions. This was true whether the disease was metastatic in origin or whether it complicated underlying renal disorders.

CLASSIFICATION

Infection of the perinephrium is always a lesion secondary to infection elsewhere in the body, whether metastatic via the blood stream or lymphatics, extension direct or indirect from adjacent structures, or rupture into the space from the kidney. Infection, however, may reach the perinephrium by means of a blood-seeded abscess in a previously normal kidney which then breaks into the perinephric space and, indeed, most authors consider this as the usual if not invariable sequence of events. Such an abscess is in a sense "renal" in origin, but the clinical implications and significance of such a lesion is clearly not the same as an abscess arising from a kidney which is itself the seat of a pyonephrosis or pyelonephritis. In this discussion, therefore, we shall classify those perinephric abscesses which are secondary to a distant focus as "metastatic" whether or not a cortical abscess of the kidney is

known to be present. Those perinephric abscesses secondary to underlying (chronic) renal disease we shall designate as "complicated." A third group is secondary to trauma to the kidney, with hematoma formation which subsequently becomes infected. Table 1 is a classification of the cases to be discussed in this paper.

TABLE I
CLASSIFICATION OF CASES OF PERINEPHRIC ABSCESS
I. Metastatic............................... 11
II. Complicated
   1. Pyonephrosis........................ 7
   2. Chronic nephritis.................... 1
   3. Tuberculosis of kidney.............. 1
   4. Actinomycosis of kidney............ 1
   5. Postoperative ureterosigmoidostomy.. 4
III. Post-traumatic.......................... 1

BACTERIOLOGY

The organism most frequently found in metastatic perinephric abscess is the staphylococcus; indeed, the recovery of that organism suggests a metastatic pathogenesis. In the other types, a wide variety of infectious agents are found. One of our patients had an infection of the perinephrium secondary to renal tuberculosis, while another was secondary to antinomy-

TABLE II
BACTERIA RECOVERED FROM TWENTY-SIX PERINEPHRIC ABSCESSES
I. Metastatic
   1. Staphylococcus aureus.............. 7
   2. Staphylococcus albus............... 1
   3. Beta hemolytic streptococcus....... 1
   4. Streptococcus fecalis and Bacillus coli. 1
   5. Unknown......................... 1
II. Complicated
   1. Staphylococcus aureus.............. 2
   2. Bacillus coli...................... 2
   3. Streptococcus fecalis and Bacillus coli. 1
   4. Bacillus pyocyaneus................ 1
   5. Tubercle bacillus.................. 1
   6. Actinomycosis.................... 1
   7. Gram-positive cocci............... 1
   8. Unknown......................... 2
III. Post-traumatic
   1. Staphylococcus aureus.............. 1
   2. Streptococcus fecalis and Bacillus coli. 1
   3. Gram-positive cocci............... 1
   4. Unknown......................... 1

cosis. Both of these patients died. Apart from these two organisms the bacterial agent appears to have no prognostic significance. Table II lists the infecting organisms found in our series of patients.

CLINICAL ASPECTS

The symptomatology of perinephric abscess as observed in children differs little,

Secondly, the *type* of abscess whether metastatic, complicated or traumatic may usually be diagnosed from the history. The history of the presence of *antecedent infec-*

NUMBER
OF
CASES
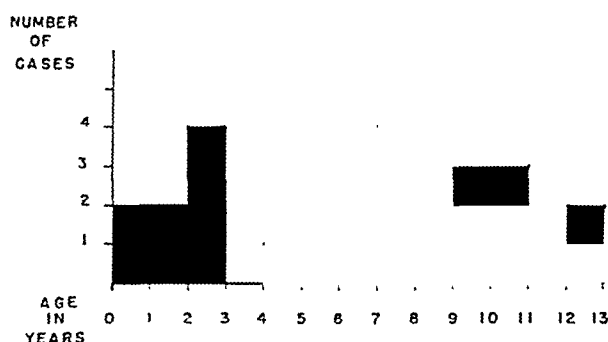
FIG. 2. Age incidence in twenty-six cases of perinephric abscess.

if any, from that seen in adults, and thus deserves but passing comment in this paper. There are three factors of clinical importance, however, which appear to us to merit emphasis:

In the first place, we have found that the site of the pain in children may be quite varied, and frequently fails to suggest the perinephrium as the site of disease. Thus many of our patients complained of pain in the peri-umbilical region, others in the hip, and others in the back. Some did, indeed, have definite flank pain. On examination, however, the signs will be found chiefly in the flank and costovertebral angle where there is almost always tenderness, usually spasm, and occasionally a mass visible or palpable. Occasionally, a visible bulge may be seen extending forward into the upper quadrant of the abdomen, and the underlying palpable mass may be felt abdominally, continuing backward into the flank. In one case a *separate* discreet mass could be felt anteriorly which was thought to be the spleen displaced forward by the underlying perinephric abscess. The important point to remember, however, is that although the pain may be referred to the abdomen, hip, or back, the disease may lie in the lumbar gutter, and the alert physician will carefully include that region in his examination.

tion, such as furuncles, otitis media or respiratory infection suggests the metastatic type, but it is surprising how frequently the history in children is lacking in details on this point, the parents having overlooked the initiating lesion because the children made no complaint at the time. A searching attempt, however, should be made in obtaining the history to establish evidence on this point.

Of much more aid in diagnosing the type of perinephric abscess is the presence or absence of *urinary complaints*. In the metastatic lesions, the onset is usually relatively abrupt, the patient becoming ill in a matter of a few hours or days. Pain and fever are universal symptoms. There may be chills, malaise, anorexia, scoliosis or limp. But urinary complaints such as dysuria, frequency, nocturia or pyuria are quite rare. In contrast, the lesions of the complicated variety associated with underlying renal disorders usually present quite a different symptomatology. The onset is insidious; there is a long history of frequency and pyuria, and occasionally dysuria; the patient has usually lost some weight and has run a low grade fever for some time; and finally pain, increased fever, limp or scoliosis is added to the picture. If, therefore, the history includes urinary complaints and a diagnosis of

perinephric abscess is made, a lesion complicating underlying renal disturbance should be suspected and a careful study of the entire urinary tract should be made.

Lastly, the frequency with which "limp" is the admitting complaint in children is noteworthy. This is due to the irritation of the psoas muscle by the overlying inflammatory process. There is limitation in extension at the hip (psoas spasm) and the patient lies with the ipsilateral knee in flexion. Other motions of the hip are normal. This situation may lead to an erroneous impression of hip-joint disease. Indeed, in one of our cases, the patient had been previously placed in leg traction for a short time before the true nature of the disease was recognized. In all children, therefore, who have a complaint of "limp" when first seen and who have in addition the constitutional symptoms of an infectious disease, perinephric abscess must be remembered and seriously considered in the differential diagnosis.

· LABORATORY DATA

The urinalysis of patients suspected of having perinephric abscess appears to be of considerable clinical importance, particularly in distinguishing the simple metastatic type from those complicating underlying renal disorders. Table III presents in some detail the urinary findings in our series of patients, both on admission and subsequent thereto. The difference between the first group (metastatic) and the second group (complicated) is quite striking.

In the first place, there was a marked difference in the appearance of albumin in the urine. In patients with a metastatic type of abscess, no albumin was present in the urine of any of our patients, except one. This patient, however, on all subsequent examinations also had negative tests for albumin. In contrast, those patients with abscesses complicating underlying renal disease almost uniformly showed positive tests for albumin; only two failed to have any albumin, and most of the remainder had strongly positive reactions.

In a similar way, examination of the urinary sediment gives valuable information in differentiating between the two groups. In the metastatic variety, no white blood cells were present except in three patients, and in these they were described as "rare" or "occasional"; and two of these patients were entirely cell-free on subsequent examination. In contrast, all but one of the patients with a complicated type of lesion had white blood cells in the sediment, and most of these were described as "many" or "loaded." These examinations, it should be mentioned, were done on the uncentrifuged specimen. (Table III.)

We believe that Table III effectively demonstrates the marked clinical importance of urinalysis in perinephric abscess in children, and the close correlation between the urinary findings and the type of abscess present. If this be interpreted with the history, we believe that an accurate preoperative diagnosis of the type of lesion, whether metastatic or complicated, can and should be made in children. This is of paramount importance, as the prognostic implications and therapeutic indications are quite different.

Other laboratory findings are of only passing interest. All of our patients had a moderate to advanced leukocytosis, the levels varying between 13,000 and 50,000 white cells per cubic millimeter. Associated with this was an increase in the proportion of polymorphonuclear leukocytes, with occasional values as high as 95 per cent. Blood cultures were taken only infrequently in our series, but were found to be positive for Staphylococcus aureus in two patients in the metastatic group. We believe that important information may be derived by this determination and intend to study this more extensively in subsequent patients.

TREATMENTS AND RESULTS

Intravenous pyelography, we believe, should be included in the preoperative study of *every patient* suspected of having perinephric abscess unless the patient is so

desperately ill that the procedure is contra-indicated. This will give confirmatory roentgenographic evidence in establishing the diagnosis, will demonstrate underlying renal abnormalities in those patients with the complicated type of lesion, and also will

incision and drainage is carried out. Occasionally, a patient is seen with a story and physical findings suggesting infection in the perinephrium, but in whom the constitutional reaction is not marked. Following rest in bed and application of local heat, the

TABLE III
URINALYSIS IN TWENTY-SIX CASES OF PERINEPHRIC ABSCESS

	Admission				Subsequent†			
	Albumin	White Cells	Red Cells	Culture*	Albumin	White Cells	Red Cells	Cultures
I. *Metastatic*								
Case 1	o	rare	o	+	o	o	o	+
2	o	o	o	o	o	o	o	o
3	o	o	o	o	o	o	o	o
4	o	o	o	—	o	o	o	—
5	+	o	o	—	o	o	o	—
6	o	o	o	—	o	o	o	—
7	o	rare	o	+	o	o	o	+
8	o	o	o	o	o	o	o	—
9	o	occas.	o	—	o	5–15	o	—
10	o	o	o	o	o	o	o	—
11	o	o	o	o	o	occas.	o	—
II. *Complicated*								
Case 1	++	many	o	—	++	loaded	o	—
2	+++	loaded	o	+	++	loaded	o	+
3	++	loaded	o	o	++	loaded	o	o
4	++++	occas.	o (casts)	—	o–++	occas.	o (casts)	o
5	o	8–10	o	o	+	loaded	o	+
6	+++	loaded	o	—	+++	loaded	o	—
7	o	o	o	+	o	o	o	—
8	+	many	o	—	++++	many	o	—
9	++++	loaded	o	o	++++	loaded	o	—
10	+++	loaded	o	o	o–++	loaded	o	o
11	+++	occas.	occas.	+	o–++	loaded	occas.	+
III. *Traumatic*								
Case 1	o	o	o	—	o	o	o	—
2	o	o	3–5	—	o	loaded	rare	+
3	o	o	o	—	o	o	o	—
4	+	o	o	—	o	occas.	o	—

* Culture symbols: + = positive; o = negative; — = not done.
† A urinary examination was chosen which as nearly as possible was representative of the urine during the patient's subsequent hospital stay.

establish the presence and gross functional status of the contralateral kidney. Thus, the procedure is of marked diagnostic and prognostic value, and will indicate further diagnostic and therapeutic steps.

The treatment varies with the type of abscess. In the metastatic variety, as soon as the diagnosis is reasonably established,

symptoms and signs gradually regress and the patient entirely recovers. We have had six patients (not included in the present series) whose history and physical findings when first seen suggested perinephric abscess, but who, under conservative therapy and observation, recovered completely without surgical treatment. It is our belief,

though of course in these cases the diagnosis was not established, that these patients probably represent cases in whom cortical abscesses were present with perhaps some inflammation of the perinephrium, but in whom the body defenses overcame the infection and no softening or abscess formation occurred. It would be unwise to incise and drain these individuals. However, once the signs and progress of the disease indicate that suppuration has occurred, further delay will merely prolong the hospital stay. It is our belief, therefore, that drainage should be performed as soon as the diagnosis of abscess is reasonably established. The abscess should be adequately opened and gently explored with the finger. Extensive exploration for the kidney which breaks down inflammatory barriers must be avoided. Drains are inserted, and the wound closed loosely to the drains.

In our group of eleven metastatic perinephric abscesses, the average duration of the history was two weeks; the average delay preoperatively in the hospital was four days, the extremes being one day and twelve days; and the average postoperative hospital stay was twenty days. There was no mortality in this group.

The treatment and prognosis of the complicated variety is entirely different and must be individualized. The therapy is really two-fold: the immediate treatment of the perinephric abscess, and the subsequent treatment of the underlying urinary tract lesion. Intravenous pyelography can usually be done preoperatively. Whether cytoscopy and retrograde studies can be made also will depend upon the condition of the patient. When possible, it is advisable to do so in order to obtain as thorough information as possible on the status of the entire urinary tract, particularly the function of the contralateral kidney. The need for this is emphasized if at the time of operation or subsequently, nephrectomy seems indicated. Limitation of the operation to incision and drainage at the first operation is thought to be the treatment of

choice. However, in two of our patients, the amount of disease of the kidney found at operation was so great that the operator decided to do a nephrectomy during the primary procedure. Both of these patients subsequently did well. In four patients, incision and drainage were performed once or more often but persistence of marked local infection led secondarily to nephrectomy. Of these patients, three died. One had antinomycosis, another had tuberculosis, while the third had congenital megaloureter. It would seem, therefore, that in children, if adequate kidney function and freedom from infection is demonstrated to exist on the contralateral side, and if the diseased kidney is shown at operation and by pyelographic studies to be seriously and irreversibly involved, primary nephrectomy may well be the procedure of choice in selected cases.

If it is thought that the kidney can be saved, simple incision and drainage is advised to overcome the perinephric infection. After the wound has healed, further studies leading to procedures to remedy the underlying lesion (for example, ureteropelvotomy for ureteropelvic stricture, or excision of posterior urethral valves) are carried out as soon as possible.

The term of hospitalization and the mortality of complicated perinephric abscess have been forbidding. The total hospital stay of the patients in this group averaged seventy days. The mortality was 45 per cent, five of the eleven patients succumbing sooner or later to their underlying lesion.

The prognosis and treatment of post-traumatic abscess is similar to that of metastatic abscess. Early drainage is usually all that is needed. In one of our patients, however, the kidney was so badly traumatized and involved in the secondary infection that primary nephrectomy was performed. The mortality in this group was zero.

We have not had sufficient experience in this disease with sulfonamide therapy to evaluate its worth. In the metastatic type

of lesion, due most frequently to Staphylococcus aureus, duration of the illness seems unaffected by the use of sulfadiazine. In the complicated type, the sulfonamides are useful in combatting the urinary infection due to Bacillus coli, but have seemed to have but little effect on the course of the inflammatory process in the perinephrium. Both the oral administration and the use of powdered drugs locally merit further study and evaluation.

SUMMARY

1. Perinephric abscess is not as rare a disease in infants and children as has been believed. A series of twenty-six proved and six possible cases is presented.

2. To classify patients on the etiologic basis of their lesion as metastatic, complicated by underlying renal disease, or secondary to trauma to the kidney, is important for prognostic and therapeutic reasons.

3. In children, a history which includes urinary complaints or a finding of albumin or white cells in the urine strongly suggests a complicated type of lesion, and indicates a thorough study of the urinary tract.

4. An intravenous pyelogram should be done preoperatively on all patients suspected of having perinephric abscess, unless they are too ill to tolerate the procedure.

5. For metastatic, or traumatic abscess, early incision and drainage is the treatment of choice.

6. In abscess complicating urinary disease, therapy must be individualized and is two-fold in purpose: first, the immediate treatment of the abscess, and second, the subsequent treatment of the underlying urinary tract disease.

7. In metastatic or traumatic abscess in children, the mortality was nil and the hospitalization averaged about three weeks.

8. In abscess complicating urinary disease in children, the mortality was 45 per cent and the hospital stay averaged about ten weeks.

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PRESENT STATUS OF GASTRIC AND DUODENAL ULCER*

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BUSINESS men make inventories. We physicians and surgeons write reviews. In both phases of endeavor, the purpose is essentially the same, i.e., to take stock, to determine progress, to learn what is missing and what is needed. This, in general, is my purpose in presenting a brief report on the present status of gastric and duodenal ulcer.

In considering this subject, I realize that we are somewhat hampered by lack of knowledge concerning the etiology of these lesions. Of course, many theories have been advanced and much evidence to support each view has been presented, but their very multiplicity is most indicative of inadequate basic information. In his review of the pathogenesis of peptic ulcer, Held[1] listed the six most probable causal theories as follows: vascular, neurogenic, acidity, catarrhal, focal infection and constitutional.

Some workers lean to the view that gastroduodenal ulcers are largely of psychogenic origin, being intimately associated with such factors as temperament, environment and economic status. More recent studies, however, have re-emphasized the importance of the acid gastric secretion in the production of such ulcers. According to Palmer,[2] the ulcer problem is one of tissue resistance versus acid attack. While not implying that excessive secretion or retention of gastric juice in the stomach is the cause of gastroduodenal ulcer, Schiffrin and Ivy[3] are of the opinion that destruction of gastric tissue results from the proteolytic action of the gastric juices. Dragstedt[4] suggests that in most cases hypersecretion of gastric juices is probably neurogenic, this secretion being abnormal in that it occurs when the stomach is empty and in the absence of the usual gastric secretion stimuli.

It seems to me that no single factor is responsible for the appearance of gastroduodenal ulcers, but rather that a combination of local, systemic and psychogenic factors act together in producing the localized lesions.

There is a growing tendency, in discussing the symptomatology, diagnosis and management of peptic ulcers, to make definite distinctions between gastric ulcers and duodenal ulcers. To me, this is a sign of progress in a poorly understood physiological derangement, for it shows that despite gaps in our knowledge of these lesions we have learned much that is of value to ourselves and our patients.

Pain, weight losses, vomiting and tarry stools are typical symptoms of gastric ulcer, but even these are variable. The duration of symptoms, while sometimes helpful in making a diagnosis, is not dependable. A correct diagnosis must depend upon the correlation of data obtained from the clinical history, the symptomatology, gastric analysis, x-ray examination and, where indicated, gastroscopy. It is only by such means that we can determine whether medical treatment should be given a trial or whether immediate surgical intervention may be indicated.

Careful correlation of such information is a prime factor in differentiating between benign and malignant gastric lesions. Such differentiation, at best, is difficult and we must call upon every diagnostic aid at our disposal to substantiate the correctness of our findings.

This fact has been strongly stressed by Walters,[5] who pointed out that attempts at medical treatment of lesions that are diagnosed as benign, but which are actually malignant, may delay necessary surgical

intervention until the lesion becomes inoperable.

"It is apparent, therefore," said Walters, "that one of our problems as diagnosticians and surgeons lies in trying to determine the pathologic nature of the lesion from the patient's history and physical examination and the reports of the roentgenologist and the gastroscopist. In many cases this is exceedingly difficult. Although the expert roentgenologist may recognize the presence of a gastric lesion in 98 per cent of cases in which it is present, he has emphasized repeatedly that there is a definite percentage of error in distinguishing a nonmalignant from a malignant gastric ulcer. This has too frequently been forgotten."

The gastroscope has become a patent aid in this differential diagnosis. Indeed, some workers (Schindler and Arndal[6]) are of the opinion that gastroscopy is more informative than roentgenoscopy. However, the general consensus of opinion, and one in which I fully concur, is that gastroscopic examination is an important supplementary aid to the x-ray (Clerf and Wirts,[7] Segal[?]). The limitations of the gastroscope should be recognized; but when the findings with this instrument are correlated with the roentgenological picture, we have the means for materially lowering the percentage of diagnostic error in differentiating between gastric ulcer and gastric carcinoma. Nor should we overlook the value of the gastroscope as a means of checking the progress of questionable gastric lesions undergoing medical treatment.

Duodenal ulcer is much more common than gastric ulcer. As Allen[9] recently stressed, this fact has led us to make generalizations which, while sound as far as duodenal ulcer is concerned, are now questionable as regards gastric ulcer. The importance of differentiating these two conditions lies in the fact that duodenal ulcers are much more amenable to medical treatment than are gastric ulcers. In the Massachusetts General Hospital, for example, it has been found that about 80 per cent of the cases of duodenal ulcer can be

successfully treated by the medical service (Allen,[9] Allen and Welch[10]). Vale[11] has estimated that over 85 per cent of cases of duodenal ulcers can be effectively treated by medical means alone. Except in cases of acute perforation, cicatrization or instances of severe and prolonged hemorrhage, surgical intervention does not appear indicated until after adequate medical management has failed.

No matter what the condition being treated, we at the DeCourcy Clinic have always emphasized the importance of considering each patient as an individual. Nowhere is this more important than in the treatment of patients with gastric or duodenal ulcers. Attempts at standardization with these cases can only result in disappointment and, very often, in failure. This, of course, implies that whatever treatment is undertaken will be determined not only by the physical condition of the patient but also on the basis of his personality, environment and economic status. This is especially pertinent in the nonsurgical procedures, but it holds quite as strongly in the postoperative and follow-up periods after surgical intervention.

It is only after such careful consideration of all the facts and findings that the decision can be made as to whether medical or surgical treatment is indicated. Obviously, medical treatment is preferable and should be used where the indications permit. However, in certain instances, the nature or location of the ulcer makes surgical intervention a necessary step from the very start.

From a consideration of the recent literature, it would appear that the medical treatment of gastroduodenal ulcer is in a state of flux— a transition from older procedures toward newer methods based upon wider knowledge. There is an apparent tendency to depend less upon antacid treatment with alkalis and to resort more and more to frequent feeding schedules. In this connection, it is significant that Vale[11] lists the four local conditions which the internist attacks by more or less direct

means in the following order: (1) pyloro-spasm, (2) hypermotility, (3) hypersecre-tion and (4) hyperacidity.

In the opinion of Andresen,[12] the concept that the production of ulcer is largely the result of acid erosion of the gastric or duodenal mucosa and that treatment directed to alkalization is absolutely neces-sary for healing is contrary to fact and experience.

"My experience of thirty years in the treatment of ulcer," he writes, "without any attempt at acid neutralization has shown just as good if not better results than in those cases in which some such antiacid treatment has been used. After all, it is safe to assume that an uncomplicated ulcer will heal spontaneously if given a chance and that treatment must be directed to reliev-ing the patient of hunger pains by frequent feedings of bland food while the ulcer is healing."

Evidence of the value of treatment along these lines is quite convincing. We all realize the desirability of avoiding condi-tions that tend to exaggerate hunger con-tractions, which, according to Quigley,[13] may give rise to distress and prevent ulcer healing through mechanical trauma to the area involved. Frequent feeding in peptic ulcer cases is now an established procedure. Two-hour feedings are generally given, with alkalis, or preferably one of the newer preparations such as aluminum hydrate or magnesium trisilicate, given during the feeding intervals. However, it has been observed that equally as good, if not better, results can be obtained by increasing the frequency of feeding, thus largely obviating the need for alkalis (Adams[14]). Here particularly, one should not forget that the patient is an individual with individual idiosyncrasies and dislikes with regard to certain foods.

Immediate and frequent feedings, based on the Meulengracht program,[15] give much promise of success in the management of bleeding gastric and duodenal ulcer. After a study of 1,396 recorded cases of gross bleeding from ulcer of the stomach or duo-denum, including thirty-two of their own cases, all treated by a prompt feeding program and a reasonable amount of fluid, Nicholson and Miller[16] stated that results on this regimen are far better than for any other type of treatment, either medical or surgical. They stressed that the type of diet is of secondary importance, provided that it be given promptly, frequently and in adequate amounts, irrespective of the degree of bleeding.

One must not overlook the fact, however, that instances of intractable hemorrhage still require the fullest co-operation of both the internist and the surgeon.

The surgical aspects of gastroduodenal ulcer have received much consideration in the recent literature. While it is evident that a large proportion of cases of duodenal ulcer respond favorably to prolonged medi-cal treatment, a similarly high percentage of beneficial results cannot be claimed for gastric ulcers.

By this, I do not wish to imply in any way that the presence of a benign gastric ulcer is an immediate indication for sur-gery. Medical treatment should be given a trial in every case in which the condition at the location of the lesion warrants such treatment. However, if after a suitable period of adequate, proper medical therapy, the ulcer fails to respond by complete dis-appearance, surgical intervention should not be withheld. Even so, bitter experience has taught that a thorough trial of appar-ently successful medical therapy cannot be relied upon to exclude the possibility that the lesion is malignant or that ulceration will not recur once the patient resumes his usual habits and activities (Walters[5]).

Unlike duodenal ulcer, surgery should not be delayed in patients with gastric ulcer in order to permit repeated trials of medical therapy. Waiting to see what will happen under various medical regimens can prove fatal and, moreover, the danger of malignancy is far too great to permit of protracted delays. The decision for or

against surgery must be made before the opportunity for operative cure is lost entirely.

It is gratifying to note the growing unanimity of opinion among surgeons regarding what is generally considered the operation of choice in gastric ulcers; namely, subtotal gastric resection (Walters,[5] Cole and Forsee[17]). Allen[9] recently wrote that "there is an increasing safety in subtotal gastrectomy that warrants eliminating the chance of overlooking malignancy in an ulcer. The results of gastrectomy in the treatment of gastric ulcer are so good that a larger percentage of such cases should be so treated."

Such opinions are based upon sober consideration of painfully gathered information. In the main, I thoroughly agree. However, as in the past, I must persist in emphasizing the importance of conservatism in gastric surgery (DeCourcy[18,19,20]). The mortality rates, though constantly improving, are still such as to indicate that radical surgery of this kind should be done only by men whose experience and constantly improving technic qualify them to do this type of operation. I am not alone in this opinion. Lahey[21] has expressed similar views.

At the DeCourcy Clinic, we have constantly been improving our technic and modifying our procedure until we have come to believe that gastrectomy, in our hands at least, is a relatively safe operation. This is substantiated by our constantly decreasing mortality figures. These results we attribute to certain modifications in operative procedures which we have adapted or developed at the Clinic.

In our procedure, we begin our resection at the upper or proximal portion of the stomach, so that dissection is made from above downward. As previously reported (DeCourcy[18,19,20]), this procedure permits us to visualize the posterior gastric wall during all the time the resection is being made. With this technic one is less likely to injure the pancreas and there is also less tendency to encounter troublesome hemor-rhage in cases in which posterior adhesions have formed.

We have also found that anterior anastomosis is preferable to posterior anastomosis. Not only is it just as efficient, but I am convinced that the adoption of anterior anastomosis has been a prime factor in lowering the mortality in our cases of stomach resection. I have expressed the opinion,[20] one which I now hold more strongly than ever before, that the general acceptance of this procedure will result in a marked drop in gastrectomy mortality everywhere.

Another important element which has done much to assure better results, one which I have stressed in previous communications,[18,19] is the use of the two-stage operation. This operation, consisting of gastro-enterostomy followed after an interval by resection of the ulcerous or cancerous area, may be used with safety on elderly patients or on patients too debilitated to withstand the complete operation at one session. We have found that in many cases of ulcer the preliminary gastrectomy has resulted in cure without the need for subsequent resection. Where, however, resection is needed, the risk is greatly lessened because the previous gastro-enterostomy greatly improves the patient's nutrition and well being. By the two-stage operation patients have an excellent chance of recovery and pulmonary complications have been absent.

Much of what has been said regarding operations for gastric ulcers obviously holds true for surgery of duodenal ulcers. Here, too, where surgery is indicated, partial or subtotal gastrectomy appears to be the operation of choice among experienced surgeons (Cole and Forsee[17]). Vale[11] believes that among standard operations, resection alone completely eliminates the factors of pylorospasm, hypermotility, hypersecretion and hyperacidity. High resection, he believes, is the only way in which most patients can be permanently cured.

Follow-up studies led Allen and Welch[10] to the belief that subtotal resection is the operation of choice. In their opinion, not less than half the stomach together with the pylorus should be removed when feasible. They found that in seventy-one survivors of seventy-six subtotal resections performed during a period of thirty-four months, no jejunal ulcers had developed up to the time of submission of their report. Moreover, it was noted that the mortality following such subtotal gastrectomy in their series of cases was not greater than that following less extensive operations.

Very significant is the observation made by these authors that the trend of operation for duodenal ulcers at the Massachusetts General Hospital is away from palliative operations. This, they believe, is doubtlessly due to the very high percentage of poor results associated with these less radical operations. Conversely every patient who has had a radical resection of the distal half or more of the stomach and pylorus has remained free of symptoms and none has as yet developed recurrent or anastomotic ulcers.

This observation reflects the general trend in surgery of the duodenum and the more radical procedures are being more widely employed because better results are obtained. We must not, however, blind ourselves to the fact that there is still a place for less radical operations. Nor should it be forgotten that resection, or indeed surgery of the stomach in general, should be in the hands of skilled and experienced operators.

A growing awareness of the importance of postoperative care and follow-up after dismissal from the hospital is another good sign evident in recent reports. Postoperative care lowers mortality and hastens recovery, while the institution of a suitable, individualized regimen enables the patient to live comfortably with his newly acquired digestive arrangement. Follow-up is essential, since only by this means can we truly evaluate the worth of newer, more radical procedures in the field of gastroduodenal surgery. The same holds true for other methods of treatment.

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PENTOTHAL SODIUM OXYGEN ANESTHESIA IN MAJOR SURGERY*

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THE ideal universal anesthetic for all major surgery has not yet been found as attested by the writings of leaders in this field of medicine. The aim of this paper is to emphasize the validity of this statement by summarizing the recent literature and to present the analytical data derived from clinical observation. It is hoped that these data may lend some influence in the changing methods of anesthesia in an effort to improve the results. In this study 837† intravenous pentothal sodium anesthetics supplemented with continuous inhalation of 100 per cent oxygen were reviewed. Every operation was an elective major procedure. The anesthetic was not used for emergency operations or for patients in shock. The work was done at the Robert Packer Hospital and Guthrie Clinic from September 1, 1939, to November 30, 1941.

GENERAL CONSIDERATIONS

Anesthesia is becoming a special field of endeavor both as an art and as a science. This has resulted because of the addition of new anesthetics in such numbers as to bewilder the surgeon. Not long ago the surgeon had only to consider the general inhalation anesthetics, ether, chloroform and nitrous-oxide-oxygen, and local or spinal anesthesia. Now ethylene, cyclopropane, avertin and barbiturates (orally or intravenously) must be considered. The rapid change in the methods and drugs now used for anesthesia makes it impossible for the practicing surgeon to be an expert with each medium. The greater share of surgery

† Since this study was finished, a total of more than 1,200 major operations have been done with this anesthetic.

for many years to come will be performed by surgeons with assistance of colleagues or nurses as anesthetists. Thus the surgeon must carry full responsibility and this in turn stimulates his interest in further developments in this vitally important field. Surgeons as a rule confine their anesthesia to a few drugs with which they are familiar and most surgeons are conscious of the injurious effects of chloroform, avertin and even ether on certain parenchymatous viscera. Many are showing discretion in their choice of anesthesia for special fields.

It appears that the art and science of anesthesia and the welfare of the patient are improved when the surgeon maintains a sense of responsibility for the patient and for the anesthetic, as the administration of an anesthetic is a major therapeutic operation. The value of good anesthesia by a trained anesthetist cannot be too strongly advised. The responsibility of the anesthetist in major operations is next to that of the surgeon. Guthrie[1] and others have pointed out that if fear can be allayed quickly by a constant stream of suggestion by the anesthetist, the patient will no doubt go to sleep quietly and recover from the anesthetic in the same state of mind. Surgical patients whose minds are racked with emotions of fear and worry are often exhausted before they are anesthetized and are fit subjects for surgical shock and death.

We are not handicapped as were the older surgeons, who, because there were no anesthetics except ether and chloroform, were obliged to hurt their patients, at times severely. The modern operator should not hurt his patients or allow them to suffer unnecessarily; the modern surgeon will not.

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As Cutler, Zollinger[2] and others have stated, the advent of anesthesia introduced a new element into surgical practice, for patients could not be persuaded to accept surgical treatment for conditions other than those which were of dire necessity. Before anesthesia no patient would accept surgery and its associated pain unless serious future trouble was believed to be inevitable. Since he knew he could be made unconscious, it was far easier to do elective surgery. With the present method of intravenous anesthesia aside from offering a considerable margin of safety and a wide utility it is very acceptable to the patient. That this is true of pentothal sodium is adequately attested by the testimony of those to whom it has been administered.

In the general considerations of pentothal sodium the various factors involved in safely preparing a patient for anesthesia, their trip through the unconscious state and afterward is in no way different in most respects than the inhalation anesthetics.

Regardless of the type of risk, the patient received the benefits derived from careful evaluation of his physiological state before operation. Patients with cardiac, pulmonary, renal or liver disease, required certain studies and a careful selection of anesthesia. All the patients in this series were brought as near as possible to normal by proper remedial methods, and the procedure and anesthetic was carefully considered so that no unnecessary risk was incurred.

Accurate evaluation of postoperative complications requires review of each step in the pre- and postoperative care of the patient, as well as each step in the operation. Many complications can be avoided through constant interest on the part of the surgeon, and by bearing in mind the dangerous part drugs play, particularly morphine which decreases the depth of respiration and in large repeated doses may be sufficient to encourage atelectasis.

In the aged, local anesthesia is frequently more desirable than any general anesthetic. This is due partly because reason and education have submerged the natural fear, and partly because in the aged, viscera are likely to be abnormal, and any anesthetic which is to circulate in the body may provoke changes that cannot be anticipated.

It is obvious to all that pre- and postoperative care of the patient is more important than the agent used. Barbiturates are not analgesic. In heavy doses they depress metabolism due to decreased emotional excitability. If the reflex irritability is not sufficiently reduced, the operation should be delayed until the proper depth of anesthesia has been reached. It usually takes one to two hours for preoperative sedative medication to act and, if properly timed, it will aid the anesthetist. If only fifteen minutes are permitted to elapse between the time the drug is given and the beginning of the anesthetic, difficulty will be experienced even in the intravenous methods. To reach a proper concentration of the agent in the blood stream, the time element is a factor. This time will vary in individual cases and according to agents employed, depending upon factors such as a nonobstructed airway, circulatory activity, degree of pain, age, degree of fever, emotional disturbance, and, as Waters and Schmidt[3] have suggested, endocrine imbalance. Depth of anesthesia, regardless of the type, can be kept on a much lighter plane if the surgeon and his assistants avoid sudden pull on retractors against the peritoneum and injudicious use of packs. Anesthetic complications, deaths and undesirable factors related to anesthesia should be constantly reviewed and recorded. The ever increasing importance of anesthesia in war medicine is a subject for consideration and the injured of this war will be very thankful for intravenous anesthesia.

CHOICE OF ANESTHESIA

Many troublesome factors have been eliminated in recent years by the addition of newer anesthetics. Some writers have shown that certain general principles underlie the choice of anesthesia. Most

patients prefer to be unconscious during the operation. One cannot dissociate mind and body; therefore, insistence upon local anesthesia in a highly neurotic individual is to court trouble and perhaps disaster. In children under ten, a general anesthetic is desired. In this series, no children under ten years of age were given intravenous pentothal sodium. As mentioned by Lemmon and Paschal,[4] in local and spinal anesthesia, preoperative sedation will diminish the amount of anesthesia required and allay any mental fears the patient may have. The pharmacologic action of pre-operative drugs and their relation to the anesthetic used, must be well understood when the choice of anesthesia is considered. For example, Guthrie and Hughes[5] point out that morphine or other hypnotic drugs should not be given in those instances in which avertin is to be used as the basal anesthetic augmented by a small amount of ether, ethylene or nitrous-oxide oxygen for additional relaxation.

It is not a simple matter to make the choice in any given instance, and it is not possible to say in general what anesthetic is best for any given type of operation. Experience is a large factor in the choice of anesthetics. As our experience in this clinic increased, it became a great deal easier to obtain excellent anesthesia even for the most difficult upper abdominal operation. Although ether is not the most desirable anesthetic, its availability is a factor to bear in mind. Other factors of importance are the danger and length of the operation, the characteristics of the patient, the temperament of the surgeon, the characteristics of the anesthetist and particularly his experience and ability in administering anesthetics. As mentioned by Sise,[6] it is poor policy to sacrifice more ideal operating conditions for the increased safety factors of any special anesthetic.

The qualities of an ideal anesthetic must, according to Seevers and Waters,[7] satisfy four individuals: First, the patient, who desires rapid and pleasant induction with an anesthetic which is nonirritating and free from unpleasant odor, and a recovery period free from discomfort; secondly, the surgeon, who would be satisfied with a nonexplosive agent, if it were capable of producing complete muscular relaxation without increased capillary bleeding; thirdly, the anesthetist, who desires an anesthetic with a wide margin of safety, capable of excretion from the body entirely unaltered, with a minimum of functional or organic injury during and following its use, sufficiently potent to permit the use of a high percentage of oxygen in the anesthetic inhalant mixture at all times, and to diffuse both sufficiently and rapidly to allow moment control of the depth of anesthesia; lastly, the manufacturer, who is interested in producing an anesthetic simply and inexpensively, one purified without difficulty and capable of storage without risk of chemical changes.

It is true, no known anesthetic fulfills all the qualifications listed above.

Our experience so far with intravenous pentothal sodium has been very encouraging and meets many of these requirements. Although the method of destruction in the body of this barbiturate is not clearly understood (Nicholson and Sise[8]), it has been shown that the process occurs so rapidly that scarcely a trace can be found in the secretions three to twelve hours after a single therapeutic dose, though the effect lasts from three to thirty minutes, depending upon the dose which is used. According to Mallinson[9] who recommends its use, it is one of the most valuable advances in the science of anesthesia made in recent times. As mentioned by Cameron,[10] Davison and Rudder[11] and many others, the intermittent method in which the anesthetic solution is administered permits maintenance of an even anesthesia, and the rapidity with which it is destroyed makes pentothal sodium anesthesia as controllable, consequently its use as safe, as that of any inhalation anesthetic. As noted in Table I, its use in this clinic has increased very rapidly in the last few years. This is also true at the Mayo Clinic, according

to Lundy and co-workers.[12] Experimental workers including Kohn-Richards and Grimes,[13] Gruhzit, Dox, Rowe and Dodd[14] and many others, have demonstrated that clinical use of the intermittent method allows one dose to be partly detoxified before the next is administered. Adams[15] considers pentothal sodium the barbiturate most acceptable for anesthesia and believes there is slight hope of producing additional effective members of the barbiturate group. Butler and Bush[16] have described the prolonged and variant effects of large doses of pentothal sodium as being due to the transformation *in vivo* of the short acting barbiturates into less active compounds of more prolonged, but less intense action.

RECENT ADVANCES IN ANESTHESIA

Each year, many additions are made to the rapidly expanding field of anesthesia. Although there has been but slight advance in the development of new anesthetic agents which are superior to older agents, valuable advances have been made in the use and application of older agents and methods, with inhalation and regional anesthesia still holding their place among the standard methods. It is our hope to prove that the increasing use of intravenous pentothal sodium anesthesia for major operations is entirely justified if the patients are properly selected and if the anesthetist is trained and there is adequate available equipment.

As reported by Lundy and Adams,[17] intravenous pentothal sodium was first recommended for short minor operations; later it progressed through a development of (1) its combination with air; (2) having patients breathe a continuous supply of 100 per cent oxygen, and (3) the still later addition of varying concentrations of nitrous oxide with oxygen. The importance of oxygen as a supplement has been stressed by many writers. In the case of hepatic disease, Ravdin[18] believes the flow of blood is impaired and anoxia of the liver results, but adequate oxygenation mini-

mizes this danger. It is his opinion that extensive liver damage occurs during ether anesthesia when the oxygen supply is reduced to 15 per cent, which concentration is 5 per cent less than air, and that frequently death is caused by anoxemia during anesthesia. Lahey[19] states that anoxemia is the basis of most anesthetic difficulties.

The continuous administration of oxygen during the intravenous anesthesia has been a fundamental improvement. It has been shown that the barbiturates as a class affect the respiration by decreasing its depth. For this reason, adequate oxygenation during a barbiturate anesthesia is obtained only by employing a concentration of oxygen higher than that found normally in the atmosphere. The continuous administration of high concentrations of oxygen during intravenous pentothal sodium anesthesia permits oxygenation to be maintained during all phases of anesthesia. Since Lundy and co-workers[20] first introduced intravenous pentothal sodium clinically at the Mayo Clinic in 1934 there has been much experimental work done to determine the minimal lethal dose of intravenous pentothal sodium in laboratory animals. This work has been of great assistance in determining the dosage for intermittent administration of the drug. It has been proved that induction of anesthesia is usually obtained by the initial administration of less than 3 mg. per kilogram of body weight and subsequent doses of less than 1 gm. per kilogram of body weight. The total amount of pentothal sodium used in an operation lasting one hour varies between 13 and 26 mg. per kilogram of body weight. Thus theoretically, there is a very safe margin between the probable minimal lethal dose in man and the amount required for anesthesia. In autopsies performed on twelve patients who died several days after operation, Carraway[21] found no pathologic changes attributable to the pentothal sodium anesthesia.

The use of intravenous pentothal sodium anesthesia has been widening and the types

of operation in which it may be used to advantage have increased. The field of application now comprises all types of surgical procedures, regardless of the operating time. The apparatus used for administration of intravenous pentothal sodium may be as simple as a sterile syringe and intravenous needle. Various new apparatus for stabilizing the source of supply of the anesthetic solution has been described by Adams,[22] Davison and Rudder,[23] and others. Some anesthetists employ a three-way valve which allows subsequent doses of the pentothal sodium solution during operation, as well as the continuous administration of intravenous fluids if the latter should be required. Hand and Sise[25] reported a precipitate formed when pentothal sodium and glucose were mixed. Blaisdell[24] and others have used various types of stands for holding the syringe containing the solution.

Pentothal sodium may be used as a supplement to local, regional or inhalation anesthetics. It is compatible clinically with all other anesthetics. Lundy and his co-workers[26] have suggested a technic by which nitrous oxide and oxygen in a fixed proportion are used as a basal anesthetic, with the addition of intravenous pentothal sodium to secure any desired depth of anesthesia. This method furnished an adequate oxygen supply, and the small doses of pentothal which are necessary make possible a shorter recovery period even after prolonged anesthesia. Adams and Lundy,[27] Hand and Sise[25] and others have demonstrated the use of intravenous penthothal sodium as a supplement to spinal anesthesia both to prolong the anesthesia when the operative procedure consumes more than the expected time, and to cause unconsciousness in the patient undergoing a long operation under spinal anesthesia. It is also used in small amounts to control nausea during spinal anesthesia.

The patient's wholehearted acceptance of intravenous pentothal sodium anesthesia has made its advancement as a general anesthetic a very rapid one. Through his personal experience, Lahey[19] calls pentothal a delightful anesthetic, and Phillips[28] believes that a patient who is able to eat a hearty lunch two hours after an operation is certainly pleased with the anesthetic.

The induction phase of anesthesia is a matter of a few seconds after the injection is made. There is no excitement during the second stage, the patient drifting into unconsciousness as if in a normal sleep. Carraway[29] mentions that this lack of excitement shortens the anesthetic time and permits the preparation of the operative site before the anesthetic is started.

The art and science of anesthesia is advancing so rapidly that a broad viewpoint regarding all anesthesia must be maintained.

Lundy[30] stresses that an anesthetic poorly timed is a disadvantage to the patient, and that many anesthetists delay unnecessarily before changing to another agent or method. This delay is no doubt due to the anesthetist's familiarity with ether, his pride in being able to anesthetize all patients with one agent or method, and his limited experience in the use of gases and/or intravenous anesthetics.

Other anesthetics have made advancements and require an open mind and a good sense of judgment to be honest and fair with each agent. For example, Lemmon and Paschal's[4] work on fractional spinal anesthesia has been widely accepted and the method has been used in this clinic with good results. Ethylene, first introduced in 1924, continues to be extensively used. There is a recent report of 35,500 cases from this clinic with gratifying results. Cyclopropane has been used extensively by the profession. It is highly explosive agent and has some action on the heart which is not completely understood. Its use in this clinic is limited to thoracic surgery. Intratracheal, local and regional anesthesia, are useful in many procedures and in the enthusiasm for newer methods their value should not be overlooked. Avertin, as a basal anesthetic, continues to be used in some institutions, but its use in this clinic

has been limited since Guthrie and Hughes[5] reported a fatality.

HISTORY INTRAVENOUS ANESTHESIA

As Tovell and Carofalo[31] state, Ore of Lyons was the first to attempt the production of anesthesia by the intravenous administration of chloral hydrate in 1872. Hedonal was employed for intravenous anesthesia in 1905, and ether was tried shortly afterward by Burkhardt[32] in 1909. Others were introduced as follows: paraldehyde in 1913, somnifene in 1924, ipral in 1925, pernocton in 1927, and avertin in 1929. These drugs were proved to be unsatisfactory for intravenous use and they have been discarded. Interest was renewed when Zerfas[33] and his associates used sodium amytal; nembutal was introduced in 1930 and evipal sodium in 1932. Pentothal sodium was first used clinically by Lundy and Tovell[34] in 1934, eunarcon was introduced in 1935, narconumal in 1936, and recently sodium thicothamyl has been added to this long list of drugs. Search for better agents continues, but so far sodium ethyl (1 methyl-butyl) thiobarbituric acid (penthothal sodium) is considered superior for the production of surgical anesthesia, while the longer acting derivatives, sodium amytal and nembutal, are reserved for the control of convulsions associated with epilepsy, eclampsia, tetanus, and strychnine poisoning. The derivatives capable of producing prolonged or sustained effect soon lost favor as surgical anesthetics because recovery was prolonged and was too frequently accompanied by restlessness of a sufficient degree to constitute a nursing problem. It may be that this trend was hastened by anesthetists who attempted to employ methods for predetermination of dosage, rather than administer those older derivatives of the barbiturate series in fractional doses during the course of surgical procedure. In spite of this, much was learned concerning these agents, and they still hold a deserved place in our armamentarium as preoperative sedatives and as satisfactory agents for the control of convulsive states, when administered intravenously or rectally in fractional doses. Adams[35] has used pentobarbital sodium (nembutal) in a 5 per cent solution intravenously, preceding a thyroidectomy, in patients having high basal metabolic rates in order to gain their co-operation during the establishment of regional anesthesia.

TABLE 1
TRENDS IN ANESTHESIA AT THE ROBERT PACKER HOSPITAL

	1937	1938	1939	1940	1941
Inhalations	3397	3465	3320	2629	2383
Spinals	96	80	111	55	86
Intravenous	72	185	307	943	991

The above table includes the three main types of anesthesia and shows the gradual increase in the use of the intravenous method at the expense of the inhalation anesthetics. This includes both major and minor procedures.

DeWan and Randall[36] first reported the use of barbituric acid derivatives in the Guthrie Clinic in 1936. Since that time intravenous pentothal sodium anesthesia has become the most frequent special anesthetic used. (Table 1.)

THEORIES OF ANESTHESIA

The mechanism by which anesthetics depress the activity of the central nervous system is poorly understood. Despite the large amount of investigation into the subject, the explanations are as yet hypothetical. Even the fundamental mechanisms underlying such a physiological occurrence as normal sleep are obscure. Because of the paucity of conclusive information, the following discussion of the theories of anesthesia will be brief. It should be noted in passing that this lack of knowledge has not interfered seriously with the clinical use of anesthetics or the continuous improvement in anesthetic agents and technics of anesthesia.

As mentioned by Goodman and Gilman,[37] there are many agents, physical and chemical, which are capable of producing depression of the central nervous system.

Cold, fatigue, lack of oxygen and certain ions (Br. Mg., etc.) are but a few of them. Clinical anesthesia is obtained especially by the use of the hydrocarbons of the methane series. A number of alkaloids also cause marked central nervous system depression. It is difficult, therefore, to believe that a single mechanism underlies the action of all these diverse agents. Nevertheless, numerous investigators have sought a unitary explanation by a study of the correlation between physical and chemical properties of drugs and their anesthetic potency. The result of most of the work is the belief that numerous anesthetic agents show affinities for lipids and for cell surfaces. In some instances, these affinities appear to be quantitatively related to anesthetic strength. Two theories of anesthesia have developed from the knowledge of these affinities, the one usually termed the "Meyer-Overton law" and the other known as the surface tension or adsorption theory. Several other explanations of anesthesia exist besides these two hypotheses.

PHYSICAL PROPERTIES

Pentothal sodium is a barbituric acid compound and a trade name for sodium ethyl (1 methyl-butyl) thiobarbiturate. It differs from nembutal by having one atom of oxygen on the urea side of the molecule replaced by an atom of sulfur. It is a lemon-colored powder, has a bitter taste, a slight odor of sulfur, dissolves readily in distilled water forming a perfectly clear solution with a yellowish tinge, and is alkaline in reaction. The solution is used in 1¼ to 10 per cent solution and preferably should be made up fresh as deterioration takes place in twenty-four hours. A cloudy solution should never be used regardless of how recently it has been prepared.

PHARMACOLOGICAL ACTIONS

Central Nervous System. All the numerous barbiturates have the same general type of depressant action on the cerebro-spinal axis. They may be considered, at least from a clinical point of view, as differing mainly in the dose in which they are effective, in speed of onset of action, in duration of the hypnotic effects and in their usefulness for specific purposes. Any degree of depression from slight sedation to deep coma can be obtained with the barbiturates. The central depressant effects are, therefore, employed to produce calmness, to induce sleep, to depress the motor cortex and thus inhibit convulsions, and to cause partial or complete surgical anesthesia. The intensity of action obtained depends not only upon the particular barbiturate selected and the dose and route of administration employed, but also in large measure upon the reflex excitability of the patient's nervous system.

In sufficient doses, barbiturates can produce surgical anesthesia characterized by the same type of irregularly descending depression as that of volatile anesthetics. The actions of barbiturates on the brain and spinal cord, however, differ in many respects from those of the volatile agents. Much experimental work has been done by Derbyshire and his associates[38] and by Forbes and Morison.[39]

Respiration. Goodman and Gilman[37] report that large doses of barbiturates are directly depressant to the medullary respiratory center and to a lesser degree to the sino-aortic chemoreceptors. Both the rate and depth of breathing are decreased and the rhythm may be irregular. However, in therapeutic doses, respirations are regular but shallow, and may be hard to detect when the drug is used without oxygen. Pallor may be noted in some cases. Since 1938 when Carraway[21] began the use of continuous oxygen inhalations throughout the operation, almost normal respiratory excursions resulted and a normal color of the skin; in addition, muscular relaxation was somewhat increased. Blackberg and Hrubetz[40] have explained the depression in depth of respiration, as being dependent upon the concentration of the drug in the blood at any one time so that large amounts

may be given safely in broken doses over a period of time.

Fortunately, the rate of destruction of the drug given in therapeutic doses is so rapid that even though depression of respiration results in momentary arrest, breathing recurs almost before cyanosis appears.

Constriction of the bronchial musculature has been shown by Adriani and Rovenstine[41] to be due to parasympathetic stimulation which is relieved by atropine.

Cardiovascular System. The barbiturates, even when used intravenously for anesthesia, do not appear to be directly toxic to the myocardium, or seriously to alter cardiac rhythm or conduction. A sharp fall in blood pressure may result from the rapid intravenous injection of a relatively safe dose of a barbiturate, but the hypotension is transitory if the dose is not too large. Ectopic beats have been explained as being due to transitory anoxemia and vanish when oxygen is given.

A review of the literature and work done by Carraway,[21] Ruth and co-workers[42] and others reveals that no electrocardiographic change in heart function was noted. In this series irregularities noticed before operation remained unaltered by the anesthetic. In hypertensives in whom the initial fall in blood pressure is greater, it soon returns to its original level and remains so. The well recognized vasodilatation which accompanies administration of pentothal sodium has been utilized in diagnostic tests for peripheral vascular disease by Weinstein[43] and others. It has been used by Allen, Lundy and Adson[44] as a prognostic agent in the preoperative consideration of essential hypertension.

Mousel[45] is of the opinion that cardiovascular collapse, if it occurs, is secondary to anoxemia caused by prolonged respiratory arrest.

Metabolic Rate. Anesthetic doses of barbiturates definitely lower oxygen consumption, as noted by Dameshek and co-workers[46] and by Shapiro.[47]

Liver and Kidneys. Scheifley and Higgins[48] suggest that the liver is not at all concerned with the destruction of pentothal and corroborates clinical observation that hepatic damage is not a contraindication. There is still some difference of opinion in this regard. Lundy and co-workers[49] state that the site of destruction of this thiobarbiturate is not known definitely at this time. The drug leaves the blood stream within a few minutes of its introduction and its effects on most patients who have disease of the liver and kidneys do not appear to differ greatly from its effects on patients with normal organs. Therefore, we do not believe that intravenous anesthesia is contraindicated when disease of the liver or kidneys is present, but it is wise to exercise greater caution with its administration.

Preparation of the patient by use of adequate protein intake as suggested by Ravdin[50] lowers any possible liver damage. Sise[51] reports that when the liver is well supplied with glycogen and when there is no lack of oxygen during and following anesthesia, liver damage need not be feared.

Intravenous pentothal sodium has been reported by Carraway[21] as being used in cases of intensive jaundice and by Ruth and co-workers[42] in massive carcinoma of the liver.

Marshall[52] contends that intravenous pentothal sodium anesthesia should not follow the administration of sulfanilamide because of the damage that the excess sulfur might incur. Lundy and Adams[75] suggest that pentothal not be used within twenty-four or forty-eight hours after the administration of another sulfur-containing drug. Our experience has shown no untoward effects when the two drugs were used at the same time in this series of patients.

As stated by Betlach and Tovell,[53] the blood sugar determinations in ordinary patients show a slight elevation after operation, and in controlled diabetics the elevation is not sufficient to cause concern. Urinary secretion is unchanged and blood

urea determinations are the same before and after operation.

STAGES OF ANESTHESIA

Pentothal sodium is usually a rapid and smooth anesthetic and when given intravenously for the production of anesthesia, it is impossible to detect the various stages as readily as when an inhalation anesthetic is given. The patient appears to fall asleep quite suddenly during the course of the injection, sleep often interrupts the patient's conversation in the middle of a sentence, and a sign or a yawn usually precedes the closing of the eyelids before the patient lapses into unconsciousness. The period of excitement noted with other general anesthetic agents is entirely eliminated. There is no other sensation experienced, except that of falling off into a natural sleep. The stage of surgical anesthesia is characterized by diminution or disappearance of superficial and deep reflexes, constricted pupils and fixed eyeballs, relaxation of the pharyngeal structures with falling backward of the tongue and shallow respiration. Muscular relaxation is best detected in the jaw muscles. The various signs differ in accordance with the amount of drug administered and with the individual patient. When an overdose of drug is given, muscular flaccidity is marked, respirations are seriously depressed and the blood pressure falls early and rapidly to shock levels.

The first and second planes of stage III anesthesia are suitable for performance of nearly all surgical operations. Most abdominal surgery is possible in the lower half of plane II because of the maximal muscular relaxation afforded therein. As a rule, this depth is needed only until the visceral structures are explored and during peritoneal closures. The depth of anesthesia is best judged by the degree of muscular relaxation which is present; anesthesia sufficient to produce abdominal relaxation, likewise will cause complete relaxation of the muscles of mastication.

The condition of the patient must be watched carefully by constant observation of the blood pressure, the rate and volume of the pulse, and the color of the mucous membranes and nailbeds. Since respiration may be all but imperceptible, Lundy[20] has devised a cotton "butterfly" which he attaches to the patient's upper lip so that the movement of air through the nostrils may be visualized. If oxygen is administered by one of the several masks, the rise and fall of the bag is an excellent means of following the rate and depth of respirations.

TABLE II

Minutes	No. of Cases	Percentage
0– 20	163	19.42
21– 30	91	10.84
31– 40	81	9.65
41– 50	96	11.44
51– 60	100	11.91
61– 80	145	17.50
81–100	77	9.17
101–120	40	4.76
121–180	40	4.76
181–over	4	0.47
Total	837	

The above table illustrates the distribution of the major cases according to the elapsed time of the anesthetic.

Several writers have mentioned that a widely dilated pupil with a fixed eyeball means momentary overdosage, while a widely moving eye with a pupil of normal size and activity indicates returning consciousness. A desirable state of surgical anesthesia is indicated by a fixed or slowly moving eyeball with a moderately dilated pupil reacting sluggishly to light.

PREOPERATIVE PREPARATION

Preoperative sedation with a "heavy" barbiturate, an opiate, and atropine is considered generally to be desirable, although a few anesthetists prefer to use nothing besides atropine preoperatively in order to avoid undue depression during and following operation. Long, Mickal and Ochsner[34] studied fifty patients undergoing thyroidec-

tomy and demonstrated that postoperatively the elapsed time before recovery from the anesthetic was much shorter in those patients receiving little preoperative sedation and intravenous pentothal anesthesia supplemented by ethylene and cyclopropane, than in those patients receiving a "heavy" barbiturate preoperatively and inhalation anesthesia alone. Mousel and Lundy,[35] Mackintosh and Pask,[36] Carraway[21] and others believe that atropine minimizes excessive tracheobronchial secretions, and, by decreasing vagal tone, acts as a prophylactic agent against transitory hiccoughing, sneezing and laryngeal spasm which have been observed infrequently during the induction of the anesthesia. In this series of cases only morphine sulfate gr. ⅙ (0.01 Gm.) and atropine sulfate gr. ¹⁄₁₀₀ (0.0006 Gm.) were given hypodermically thirty to forty-five minutes preoperatively.

ADMINISTRATION

Ordinarily two anesthetists are required to administer oxygen and the intravenous anesthetic, but since the advent of various mechanical devices (Fig. 1) only one is now required.

As reported by Hawk,[57] the technic of administration in this clinic has remained practically the same for several years. The patient is placed on the operating table and adjusted in the position desired for opera-

Fig. 1. Pentothal sodium oxygen anesthesia in progress showing the Boothby-Lovelace-Bulbulian mask, the Blaisdell apparatus for intermittent injection and other equipment used during the procedure.

tion. The arm selected for injection is brought out to a right angle with the body and attached to an arm rest. A soft rubber

Fig. 2. Illustrating usual type venipuncture with 20 cc. syringe and No. 20 needle.

tubing tourniquet is applied to the arm to distend the veins and the needle is inserted into the vein. A No. 20 gauge needle is placed on a 20 cc. syringe (Fig. 4), or if the mechanical apparatus is used, the needle is attached to sterile standard tubing that connects with the 20 cc. syringe held stationary in its receptacle. (Fig. 2.) The patient is then asked to count slowly and 2 cc. of a 5 per cent pentothal sodium solution is injected during the first ten to fifteen seconds. After a short pause to determine any idiosyncrasy to the drug and allow for even distribution in the blood stream, the injection is continued slowly until the patient stops counting. At this stage the eyelids are closed, respirations are shallow, and the jaw muscles relaxed. A Boothby-Lovelace-Bulbulian mask with respiratory bag is then applied and the jaw is supported by the anesthetist. (Fig. 3.)

The oxygen inhalations are started with a flow of about four liters a minute, but since the vital lung capacity varies in different individuals, it may be necessary to increase the flow of oxygen to five or more liters per minute. The rise and fall of the respiratory bag demonstrates the respiratory excursions. No additional solution should be injected until satisfactory respirations are established.

No established dosage can be indicated because of the marked variation in indi-

French—Anesthesia in Surgery

vidual susceptibility, but it has been stated by various writers that the necessary dosage varies directly as the muscular

detoxification before anesthetic concentrations are produced. The function of respiration must be further protected by diligent
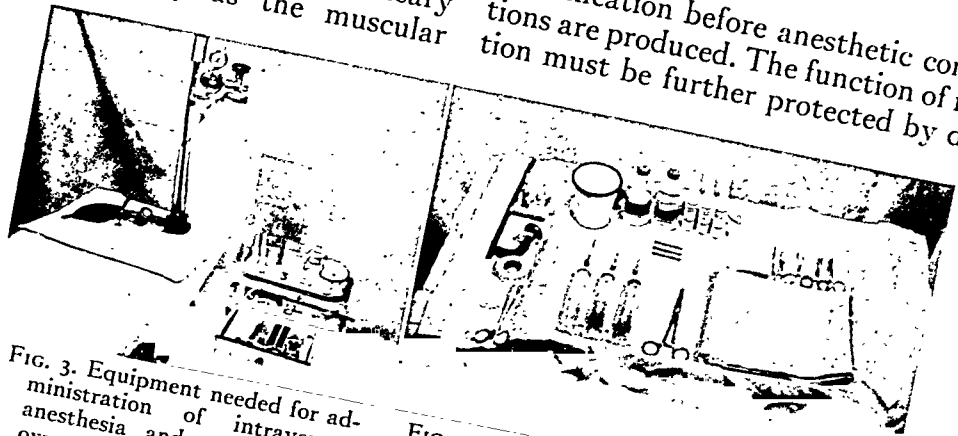
FIG. 3. Equipment needed for administration of intravenous anesthesia and 100 per cent oxygen: (1) Boothby-Lovelace-Bulbulian mask with respirator and oxygen tanks; (2) alcohol sponge; (3) syringe and needle; (4) adhesive tape; (5) airways; (6) tourniquet; (7) table.

FIG. 4. The equipment for the sterile intravenous anesthesia tray.

component of the patient. The toxic, anemic or cachectic patient usually requires a proportionately smaller amount. For the usual individual 4 to 8 cc. of a 2.5 per cent solution is required for induction of anesthesia and additional administrations of 1 or 2 cc. spaced fifteen to twenty seconds apart, as the indications arise. A total of 1 to 2 Gm. is usually sufficient to maintain adequate relaxation for an hour's anesthesia. It usually requires about three to five minutes to produce a state of surgical anesthesia. An increase in the respiratory rate, slight muscular movements and return of the swallowing and eye reflexes are signs that the patient is coming out of the anesthesia. It has been repeatedly noticed that skin incisions, unless the skin was previously anesthetized by local anesthesia, require more anesthesia to relieve pain than many major operations.

As Ruth[42] and others have stressed, experience in the administration of the anesthetic is the predominant factor in the problem of timing the rate of injection. It appears that it is a mean between a rapid injection which quickly depresses the respiratory center and an injection which is sufficiently retarded to allow for the drug's

maintenance of a patent respiratory tract. Relaxation of the soft tissues about the upper respiratory tract is likely to occur and thereby impinge on its patency. At the

TABLE III

CHART FOR TIME OF RECOVERY AND AMOUNT OF ANESTHETIC

Amount Anesthetic (Average)	Recovery Time (Average)
35.4 cc. of 5 per cent	2 hrs. 36 min.
50.3 cc. of 2½ per cent	
Greatest Amount Anesthetic	Longest Recovery Time
115 cc. of 5 per cent	18 hrs. 5 min.
Smallest Amount Anesthetic	Shortest Recovery Time
3.5 cc. of 5 per cent	5 min.
11 cc. of 2½ per cent	

The above table illustrates the direct relation between the amount of anesthetic used and the recovery time. Recovery time is measured from the time of the last injection of the intravenous drug.

same time, obtundation of both pharyngeal and laryngeal reflexes does not occur until quite profound anesthesia has become established. Therefore, when an adequate airway cannot be maintained by proper position of the head, insertion of a pharyngeal airway may be necessary.

Recovery from the anesthetic occurs more quickly when the total dose of pentothal sodium is small. If possible, the anesthesia should be lightened toward the end of the operation in order that patients may respond before leaving the operating table. (Table III.)

Near the close of the operation the needle may be withdrawn and a sterile cotton sponge applied with adhesive tape. If the respirations have been shallow, hyperventilation by carbon dioxide oxygen mixture is used. If a mechanical airway is necessary to prevent the falling back of the tongue, the patient is sent back to his bed with this in place. Earlier in the work, coramine or picrotoxin was given intravenously to hasten recovery, but this has since been discontinued.

Since it has been shown by Lundy[58] that the incidence of phlebitis in the vein receiving the solution is directly proportionate to the concentration of the drug (one case in 1,000 with the use of 5 per cent solution; one case in 3,000 with 2.5 per cent solution), a concentration of 5 or 2.5 per cent solution is usually employed for induction of anesthesia while a 2.5 or a 1.25 per cent solution may be used for subsequent injections.

SYMPTOMS AND TREATMENT OF OVERDOSAGE

An overdosage of intravenous pentothal sodium results in imperceptible respiration. Cessation of respiration is usually accompanied by the development of cyanosis. Pulse rate increase and muscular relaxation become marked. Treatment consists in stopping the administration of the intravenous anesthetic, establishing an airway and performing artificial respiration. Oxygen and carbon dioxide should be administered and respiratory stimulants such as nickethamide, metrazol or picrotoxin, should be injected intravenously in sufficient dosage to obtain a stimulation of respiration. Lundy[59] believes the general tendency is to abandon the routine use of respiratory stimulants.

POSTANESTHETIC MANAGEMENT

After operation the patient must be attended constantly until his reflexes return. It is usually necessary to support the jaw during a part of this period. This par-

ticular precaution cannot be too strongly emphasized. Lundy[60] advises the continuous administration of oxygen until signs of recovery appear.

It has been mentioned by many writers that one of the most desirable characteristics of the recovery period following intravenous pentothal sodium is the patient's freedom from nausea and vomiting. In this series, nausea and vomiting occurred in only 30 per cent of the cases. Cameron[10] and others have noticed that vomiting is absent in patients who have had no preliminary medication. Vomiting is a severe handicap, particularly to the diabetic patient, and makes the selection of anesthetic agent and a preanesthetic drug particularly desirable in this group of patients. Lundy and Tovell,[20] Carraway[21] and others have observed the absence of sweating at the time of the operation and during the recovery period. It is believed this characteristic must be partially responsible for the fact that shock seems to be less than after other types of anesthetics.

Following short operations, the length of the recovery period is extremely short, being calculated by Cameron,[10] Lundy, Touhy and Adams[61] and others, as from five to thirty minutes. Its length is approximately proportionate to the amount of the drug administered. Davison and Rudder[11] pointed out, and it was found true also in this series following the longer procedures, that full recovery may be delayed for as long as six to twelve hours or longer. However, even in these cases, the patient may be aroused in from ten to sixty minutes, although undisturbed he prefers to sleep on. As noted in Table III, there are wide variations in reaction times but no ill effects followed many hours of sleep.

ANESTHETIC ACCIDENTS AND COMPLICATIONS

According to Guedel's classification,[62] a number of accidents and complications may occur incident to the administration of an anesthetic. This is true both in inhalation and in intravenous anesthesia.

It is important to anticipate and prevent these, for they may prove fatal.

The principal causes of dangerous hypotension during anesthesia are hemorrhage and shock. Regardless of the etiological mechanism, the ultimate result is tissue anoxia. Hemorrhage is mainly a surgical problem and until transfusions can be performed, intravenous administration of fluids and the inhalation of a high percent-

As seen only in stage I, respiratory arrest occurs from breath holding and is due to emotional disturbance or laryngeal irritations. Pharyngeal spasm which appears at the end of stage I is more troublesome and may persist intermittently through stage II. Attempts to maintain an airway or force oxygen past the obstruction usually fail, and one must wait until the carbon dioxide concentration rises and the oxygen content

TABLE IV
POSTOPERATIVE COMPLICATIONS INTRAVENOUS PENTOTHAL SODIUM

Type of Operation	Amt. Anesthetic		Reaction Time	Complication
	C.c.	Per Cent		
Cholecystectomy and appendectomy	40	5	47 min.	Atelectasis rt. lower lobe
Posterior Gastro-enterostomy	40	5	1 hr. 25 min.	Pleurisy (left side)
Supravaginal hysterectomy	20	5	1 hr.	Diaphragmatic pleurisy left
Cholecystectomy	21	5	25 min.	Pulmonary infarct, left
Bilateral inguinal herniorrhaphy	35	5	1 hr. 15 min.	Pulmonary embolism
Bilateral inguinal herniorrhaphy	41	5	1 hr. 30 min.	Atelectasis rt. lower lobe
Bilateral inguinal herniorrhaphy	70	5	6 hr. 50 min.	Atelectasis rt. lower lobe
Left radical mastectomy	24	5	1 hr. 30 min.	Infarct rt. lower lobe
Open reduction fractured ankle	47	2½	1 hr. 10 min.	Coronary occlusion
Nicola operation on shoulder	89	5	5 hr. 45 min.	Pneumonia, broncho
Plastic operation on hip	75	5	5 hr. 40 min.	Mild slough at site of injection drug
Unilateral herniorrhaphy and repair undescended testicle	46	5	9 hr. 40 min.	Atelectasis rt.
Appendectomy and exploration abdomen	48	5	1 hr. 5 min.	Bronchopneumonia
Cholecystectomy	56	5	5 hr. 10 min.	Diaphragmatic pleurisy and rt. atelectasis
Cholecystectomy and thyroidectomy	63	5	4 hr. 5 min.	Slough at site injection in arm
Total hysterectomy	58	5	2 hr. 20 min.	Atelectasis rt.
Cholecystectomy and repair ventral hernia	54	5	5 hr. 20 min.	Massive collapse rt. lung

The above table illustrates the type of major operation, the amount and percentage of pentothal sodium used, the reaction time and the complication. This is the total list of complications that occurred in 837 consecutive major operations.

age of oxygen are helpful. Carbon dioxide may also be given because it increases the tone of arterial walls.

Shock, whether due to the anesthetic or to the surgical procedure, has the same underlying pathological physiology. It can be prevented by avoiding anesthesia deeper than is absolutely necessary, by conserving body heat and moisture, by maintaining an optimal carbon dioxide level, by allowing sufficient oxygen at all times, and by treating the tissues gently.

of the blood falls sufficiently to break through the spasm and stimulate breathing.

If the muscles of the lower jaw are sufficiently relaxed, the base of the tongue may obstruct respiration by falling against the posterior wall of the pharynx. This has been misnamed "tongue swallowing" and is rarely observed during the first two stages of anesthesia, but may occur after the patient is returned to his bed if he is placed in supine position. The danger may be circumvented by the use of a pharyngeal

airway or by holding the lower jaw forward. Another form of mechanical respiratory obstruction is due to the aspiration of débris. Foreign objects may lodge in the pharynx, trachea, bronchi, or, if liquid, in the lungs. Teeth, sponges, instruments, blood, pus or mucus are the common offenders. Secretions of mucus should be controlled by adequate doses of atropine or scopolamine.

Massive collapse of the lung, when it occurs, is usually secondary to anesthesia and follows shallow respiration and bronchial obstruction, particularly from mucus. Atelectasis is due to complete absorption of gases by the blood flowing through the lung distal to an occlusion of a main bronchus, and occurs within a few minutes. It may not be noticed if a closed system with oxygen tension is being used. However, as soon as the anesthetic is stopped, cyanosis and dyspnea are apparent and physical examination reveals evidence of pulmonary collapse. As noted in Table IV, one case of massive collapse of the lung occurred in this series of seventeen complications and immediate treatment by means of aspiration and hyperventilation effected his prompt recovery. Atelectasis often results in serious postoperative pneumonia. Prevention depends upon maintaining sufficient depth of respiration by inhalation of carbon dioxide and vigorous hyperpnea induced with carbon dioxide at the end of each operation in which breathing has been shallow. In treating fully developed atelectasis, oxygen and carbon dioxide should be administered for an hour or longer and direct bronchoscopic removal of the mucous plug may be attempted, if early evidence of improvement is not forthcoming. As noted in Table IV, six cases of atelectasis developed in this series and all recovered after the above treatment was instituted.

Long and Ochsner[63] have reviewed a large collection of intravenous pentothal sodium anesthetics and state, "remarkable in this collection of 54,851 cases is the absence of any single report of postoperative pulmonary collapse or pneumonia; symptoms of milder respiratory complications were almost as rare."

ANESTHETIC DEATHS

There were no deaths in this series of major operations. Two deaths, however, have occurred during minor operations, both patients having been known to be long-standing heart cases with previous proved coronary thromboses. It is desired to emphasize that the anesthetic is not always the cause of death. Indeed, the cause may be extremely difficult to determine.

Death from pentothal sodium, if it occurs early, is usually the result of paralysis of the respiratory center. The shorter acting barbiturates are particularly prone to produce death from respiratory depression. If death is delayed, vasomotor collapse and hypostatic pneumonia are frequently the causes of the fatal issue. Bronchopneumonia may occur in a patient who has regained consciousness and apparently recovered, and in this complication a guarded prognosis is advisable. The cerebral changes which occur in a fatal case have been described by Hassin[64] as a morphological alteration of ganglion cells in the brain, being usually marked in the medulla and olivary bodies, and often associated with neuronopagy without marked macroglial or microglial reactive phenomena. More important and dangerous is the occurrence of cerebral edema with distention of the subarachnoid space and the cerebral tissue spaces. Beecher and Moyer[65] have done extensive work on the mechanics of respiratory failure in deaths from barbiturate anesthesia.

As stated previously, in twelve autopsies on patients who died several days after pentothal sodium anesthesia, Carraway[21] found no pathologic changes attributable to intravenous pentothal sodium. Weese,[66] in calling attention to a number of deaths reported during operation done under various intravenous barbiturate anesthetics for sublingual infections, advances the following interesting explanation on the basis of experimental work performed on dogs.

Infection in the area of the carotid sinus which normally exerts an inhibitory effect on the respiratory center, increases the sensitivity of this structure by impairing its blood supply. When infection is present, the fast acting intravenous barbiturates anesthetize the central nervous system more rapidly than they anesthetize the carotid sinus. If the carotid sinus is traumatized by an operation begun during this phase of anesthesia, such powerful inhibition of the respiratory center may result in death. Weese advises that anesthesia continue for at least five minutes before the beginning of any operative procedure for infection in the neck, so that sufficient time will be allowed for the anesthetizing of this portion of the vagus system.

ANESTHETIC CHARTS

As noticed in Tables v, vi and vii, careful records of every anesthetic is kept. Cutler and Zollinger[2] have written that nothing

TABLE V
ANESTHESIA AND OPERATION RECORD

Name.............Age....Date.......No. B
Surgeon................Assistant..............
Surgical Nurse... ....Doctor Referring.......
Operation started ....Operation ended.... .....
Drainage...............Packs {Used..... .....
                               {Recovered.. ......
Closure.......................................

Pulse	Respirations	Anesthetic
....	.. ..	Ether...Gas...
		Local...Intravenous...
		Charge S......

Comments...................................

Operation...................................

The above record is filled in at the head of the table before and during operation and then is given to the operating room stenographer to transcribe on the permanent operative record.

contributes so greatly to the full appreciation of the patient's condition at any given time as the data on these charts.

In addition to furnishing vitally important information during the ordeal, this chart contains specific information concerning the general condition of the patient.

It should show pre- and postoperative diagnosis in order to provide an educational check and stimulus to the staff. It should also contain a correct title of the procedure for the benefit of the record room staff of institutions where proper listing is kept of

TABLE VI

Operative Record	ROBERT PACKER HOSPITAL Sayre, Pa.	B

NAME   DATE

Postoperative Diagnosis

Preoperative Diagnosis

Surgeon		Assistants		

Referring Doctor	Anesthetist	Respiration	Pulse	Blood Pressure

Operation Started   Operation Ended

Sponges Used   Sponges Recovered   _____
Packs Used   Packs Recovered
Instrument Nurse   Sponge Nurse   _____

Anesthetic   Amount   ℀   _____

Summary

Drainage

Pathological Report

Operative Findings

Operative Procedure

Signature of Surgeon

The above record is the permanent operative record that includes all that takes place in the operating room and is completed at the close of each operation by dictation to a full-time medical stenographer and then signed by the surgeon himself.

surgical operations and of diagnoses. Comments by the anesthetists or surgeons are made on the face of the records and are valuable in the study of postoperative pulmonary complications. The notation of drains may save much worry in the postoperative period when memory often fails one. All pertinent information about the amount of anesthesia, who gave it, time of operation and the operative procedure, is a part of the chart. This chart is then incorporated in the main record which carries exactly the same house number for all departments and on all subsequent admissions to the clinic or hospital. The patient is never seen without the entire

record being at hand. Special charts as noted in Table VII have been kept when

TABLE VII

SPECIAL ANESTHETIC RECORD SHEET

Anesthetic No. ......

THE ROBERT PACKER HOSPITAL

Case No. B.... Room.... Ward.... Date............

Patient's Name................................ Age....

Operation......................................

Anesthetist......................................

Type Anesthetic Drug.............Total Amount............

Operation Started...... Ended..... % Concentration......

Anesthetic Started..... Condition at start...............

Condition during Anesthetic

    B. P. Start   ....   B. P. Finish ....

    Nausea   ....   Hiccoughs ....

    Vomiting   ....

    Relaxation   ....

    Oxygen Used   ....

Postoperative Reaction

    Time Reacted ....   B. P. ....

    Nausea   ....

    Vomiting   ....

    Gas Pains   ....

    Distention   ....

Remarks......................................

The above record sheet was kept on all patients receiving pentothal sodium oxygen anesthesia and their postoperative course was followed until the patient left the hospital.

new anesthetics are used in order further to evaluate their usefulness.

POSTOPERATIVE SEDATION

Sedatives should be given with caution after all major abdominal or thoracic operations. In this type of case, deep and regular respiration may prevent postoperative pulmonary complications. After operation sedatives should be given sparingly in all cases in which there is evidence of mucus in the respiratory tract during anesthesia. If such patients are allowed to recover from the anesthesia and postoperative sedation sufficiently, the cough reflex returns and they can be encouraged to breathe deeply and to cough up the mucus. If mucus is left in the trachea and bronchi, and if the lower lobes of the lungs are not fully expanded, atelectasis and pneumonia may develop later. These simple precautions have been mentioned by Mousel and Lundy[67] and many others.

It is believed that postoperative pneumonia often is preceded by pulmonary atelectasis. Tracheobronchial aspirations should be carried out before the patient is removed from the operating room in every major surgical case in which there is evi-

dence of mucus in the trachea. This may be done under direct vision of the bronchoscope whenever possible, and one should have no hesitancy in bronchoscoping a patient postoperatively if an atelectasis or massive collapse is present.

SPECIAL FIELDS OF USE

In perusing the literature, one is impressed with the diversity of opinions concerning the scope of the usefulness of pentothal sodium. Many clinicians, including Adams,[68] Cameron,[10] Pratt, Tatum, Hathaway and Water,[69] Ruth, Milligan and Charleroy,[42] advise its use only for short operations not requiring marked muscular relaxation. This group lists as contraindications such conditions as asthma and cardiac decompensation, and contends that abdominal operations and other procedures requiring muscular relaxation are not feasible under pentothal sodium. Still others, including Carraway,[21] Kassebohm and Schreiber,[70] Thomas[71] and Tucker,[72] have doubted that there are any contraindications to its use, and indeed list so-called contraindications as actual indications for intravenous pentothal sodium. During the last three years, anesthetists who were at first very cautious in the use of pentothal sodium have found wider uses for the method.

Jarman,[73] Moore[74] and Phillips[25] have found intravenous pentothal sodium valuable in the exigencies of military surgery. It is of particular value to victims of chemical warfare when it is desirable to use an anesthetic agent which is not irritating to the lungs. Solutions are relatively stable for from twenty-four to forty-eight hours, and as much as 500 cc. can be made up at once and used over that period. Because of the availability of the drug, the ease with which it is transported and administered, the short induction time and quiet recovery, valuable time and energy may be conserved when one trained anesthetist must be responsible for numerous anesthesias in a short period.

While intravenous pentothal sodium is employed by some surgeons as the anesthetic of choice in all surgical procedures, its use is limited to certain operations by others. The absence of the anesthetist and his apparatus from the region of the operative field, makes the use of intravenous pentothal sodium desirable in operations on the head and neck, and in those cases in which the use of the cautery or electrosurgical unit creates a distinct fire hazard. It is reported as a desirable anesthetic by urologists, ophthalmologists, psychiatrists and neurologists, bronchoscopists and laryngologists, and obstetricians.

Adams,[75] Lundy and Adams,[76] Priestly and Schulte[77] and others point out that the elderly and debilitated tolerate intravenous pentothal sodium especially well. They also mention that it is a method of choice not only in the poor risk groups, but also in diabetes, myocardial degeneration, asthma, chronic bronchitis and pulmonary tuberculosis.

Lundy,[34] Lundy and Tovell[20] and Mallinson[9] have reported its use in patients in whom, for one reason or another, inhalation and spinal anesthetics are contraindicated. As mentioned before, the absence of sweating during the operation and recovery period must be partially responsible for the fact that shock seems to be less than after other types of anesthesia. In this series no patients were operated upon while in shock and no patient developed shock during or after operation.

ADVANTAGES OF PENTOTHAL SODIUM

Aside from the importance of the safety factor, the degree of muscular relaxation produced by an anesthetic is the next principal requisite. In this series, it was found that intravenous pentothal sodium anesthesia, supplemented by continuous inhalation of 100 per cent oxygen, produced muscular relaxation equal to that of spinal anesthesia. This observation is so important it should be stressed, as many authors do not agree. The concomitant use of oxygen and intravenous pentothal sodium thus permits the maintenance of a depth of anesthesia allowing complete muscular relaxation, and makes intravenous pentothal sodium more widely applicable in various surgical procedures. At the same time, the more quiet breathing is in itself a considerable advantage in that abdominal operations are complicated less by interruption from straining and forceful respiration than under any other form of anesthesia. Carraway,[21] Organe and Broad[78] and others believe this factor undoubtedly has considerable effect in increasing the speed of operation and in reducing the morbidity therefrom.

Because of the similarity of the mode of induction to the universal "blood test," the usual apprehensive thyrotoxic patient may be put to sleep in her room without any knowledge that operation is contemplated. Long, Mickal and Ochsner[54] have shown that the wisdom of this method of induction is reflected in the lessening of postoperative reaction in the hyperthyroid patient, as demonstrated by lowered pulse and temperature curves.

DISADVANTAGES

Pentothal sodium oxygen anesthesia requires two experienced anesthetists to administer it safely and they must be prepared to meet all anesthetic emergencies at all times. This is particularly true for prolonged procedures. For major procedures, these requirements would limit its employment to hospitals except in rare instances. The time that an attendant remains with the patient after his or her return to bed should be considered a minor disadvantage. As mentioned by Hawk,[57] the ease of administration is considered a disadvantage, since the drug can be used without oxygen and the only equipment necessary consists of a 20 cc. syringe, a 20-gauge needle, distilled water, and the ability to puncture a vein, thus enabling the experienced to use it in the office or home without the proper means of meeting an emergency. The elimination of the very young as desirable candidates for this type

of anesthesia may be regarded as a disadvantage. Whether the early detection of a postoperative hemorrhage, as might occur in a gastric resection, could be observed during the recovery period is subject to consideration. No postoperative hemorrhage occurred in this series.

COMPLICATIONS

The incidence of postoperative complications is no greater with pentothal sodium oxygen anesthesia (Table VIII) than with ethylene anesthesia. According to Table IV,

TABLE VIII
POSTOPERATIVE COMPLICATIONS

	Intravenous Pentothal Sodium		Ethylene	
	Cases	Complications	Cases	Complications
December 1939.	21	1	95	1
January 1940...	72	2	81	1
March 1940....	63	2	60	3
April 1940.....	65	1	79	1
May 1940......	103	1	61	0
July 1940......	69	1	88	0
August 1940....	98	1	84	0
September 1940	84	1	56	2
October 1940...	90	1	67	0
April 1941.....	100	1	64	2
May 1941......	83	1	74	0
September 1941	83	3	72	1
October 1941...	97	1	54	2
Total........	1028	17 (1.8%)	935	13 (1.3%)

The above table lists all complications that occurred in patients having pentothal sodium oxygen anesthesia as compared with those having ethylene anesthesia during the same months. Only the months when complications occurred are listed and all cases both major and minor are listed.

one patient suffered a mild coronary attack several days after operation and two developed pneumonia. Atelectasis occurred no more frequently than after other types of general anesthesia, which may possibly be due in part to the rigid routine postoperative regimen for all patients anesthetized with intravenous pentothal sodium. The postoperative regimen includes deep

breathing and leg exercises twice daily for five minutes and ventilations with carbon dioxide several times a day when indicated. A minimum amount of sedation should be given until the patient is completely conscious. Four patients developed induration at the site of injection of the intravenous pentothal sodium and in two patients a slough of a small area of skin occurred. (Table IV.) There have been fewer cases of venous thrombosis and sloughing since the use of 2.5 or 5 per cent solutions has been adopted. There are scanty reports in the literature regarding complications following intravenous pentothal sodium anesthesia.

ANALYSIS OF CASES AND STATISTICS

In this clinic, the first approach to the use of pentothal sodium as an intravenous

TABLE IX

Age in Years	No. of Cases	Per Cent of Cases
1-10	3	0.03
11-20	123	14.6
21-30	128	15.2
31-40	142	16.9
41-50	177	21.1
51-60	117	13.9
61-70	104	12.4
71-80	40	4.7
81-90	3	0.03

The above table illustrates the age grouping of major operative cases receiving pentothal sodium oxygen anesthesia.

anesthetic was with caution. As reported by Hawk,[57] it was first used for minor operations. Major operations were first performed under intravenous pentothal sodium anesthesia after Carraway[21] introduced the method of using continuous inhalation of oxygen during the operation. The beneficial effects of oxygen permitted its use for all types of surgical procedures with certain limitations and few contraindications. The following data have been tabulated only in those cases in which oxygen was used and only in major operations. The 837 cases used in this study

make up only 33 per cent of the total number of intravenous pentothal sodium anesthetics given during this period. The remaining 1,700 minor operations are not included in this report.

The average amount of 5 per cent solution required for induction was 3.98 cc. and 5.41 cc. of a 2.5 per cent solution, with 1 cc. being the smallest amount in both strengths and 10 cc. of the 5 per cent and 11 cc. of the 2.5 per cent the largest amount. This tends to show that the amount of agent required to produce anesthesia varies with each individual, as noticed in Table III. A grouping of ages in Table IX disclosed that 264 of the 837 patients were beyond the age of fifty years. Of these, 104 were between sixty-one and seventy, forty between seventy-one and eighty and three between eighty-one and ninety years. The youngest patient was ten years old and the oldest eighty-two years.

These figures tend to show that the anesthetic can be safely used for individuals past middle life. The reaction time may occur a few minutes after the anesthetic is stopped in shorter procedures, but in longer operations it varies in length in direct relation to the time consumed, as noted in Table III. The average reaction time in this series of major procedures was two hours and thirty-six minutes, with one patient requiring eighteen hours and five minutes before responding. The two longest operations were similar orthopedic procedures lasting over three hours; the one required 97 cc. of a 5 per cent solution and had a reaction time of three hours and fifty-eight minutes, and the other required 50 cc. with a reaction time of two hours and ten minutes.

A prolonged sleep often followed the reaction time with one patient sleeping approximately ten hours before recovery was complete, but no ill effects have been noted from either the long reaction time or recovery period. The incidence of hiccoughs was .03870 per cent. All patients received atropine preoperatively which prevented bronchial and pharyngeal secre-

tion. Nausea and vomiting were recorded in 30 per cent of the cases, but this figure includes a number of questionable cases of nausea. There were no fatalities in this series due to anesthesia.

TABLE X

TYPES OF MAJOR OPERATIONS PERFORMED WITH PENTOTHAL SODIUM OXYGEN ANESTHESIA

Types	No. of Cases
Salpingectomy	6
Appendectomy	122
Cholecystectomy	80
Supravaginal hysterectomy	65
Cholecystostomy	5
Herniorrhaphy	82
Bone plastic operation	33
Vaginal hysterectomy	27
Total hysterectomy	8
Mastectomy	28
Oophorectomy	21
Laparotomy (abdominal)	21
Bowel resection	12
Suprapubic cystostomy	17
Open reduction bone	23
Hysteropexy	13
Reduction of fracture	11
Suprapubic prostatectomy	9
Gastro-enterostomy	12
Ligation both tubes	14
Tendon plastic operation	12
Arthrotomy	8
Enterostomy	5
Colostomy	7
Nephrectomy	9
Arthroplasty hip	10
Arthrodesis major joint	3
Gastrostomy	4
Ileo colostomy	3
Gastric resection	4
Splenectomy	2
Amputation leg	2
Ureterotomy	3
Vaginal myomectomy	3
Choledochostomy	-
Perforated duodenal ulcer	1
Pyloroplasty	4
Resection scalenus anticus and unilateral thyroidectomy	1
Cholecystogastrostomy	1
Disarticulation hip	1
Fusion spine	2
One stage abdomino-perineal resection colon	2
Closure disruption abdominal wound	2
Nephrostomy	2

As noticed in Table x, various types of major operations were done. Operations on the biliary system often prove difficult at best and a great deal depends upon the anesthetic for exposure; ninety-two operations were performed on the gallbladder

and ducts under this form of anesthesia with gratifying results. The quiet, even respirations, satisfactory relaxation, and the ease of control of any straining allowed adequate exposure in fifteen to twenty seconds by an additional injection of 1 cc. of the solution. Muscular relaxation is the main reason given for using spinal anesthesia in performing gastrointestinal surgery, but, as noted in Table x, in fifteen bowel resections, twelve gastro-enterostomies, four gastric resections, seven colostomies and three ileocolostomies, relaxation was found to equal that of any other anesthetic.

TABLE XI

APPROXIMATE COST OF INTRAVENOUS ANESTHETIC EQUIPMENT

1.	Oxygen tank each.........................	$16.00
2.	Boothby-Lovelace-Bulbulian mask and valve adapter................................	8.00
3.	Pentothal sodium—1 Gr. ampoule.........	.67
4.	Water—20 cc. ampoule...................	.18
5.	One 20 cc. syringe......................	2.00
6.	Number 20 needles, per dozen...........	1.50

In pelvic cases first placed in the Trendelenburg position before the anesthetic was started, there were sixty-five supravaginal hysterectomies, thirteen hysteropexies and twenty-seven operations upon the tubes and ovaries. On opening the abdomen, it was found that the intestine had in many cases gravitated out of the pelvis, requiring only the insertion of a part of a gauze pack to obtain exposure. The prostatic case is often a problem from an anesthetic standpoint due to age and poor physical condition, but in nine suprapubic prostatectomies, no difficulties were encountered. In twenty-eight simple and radical mastectomies, nine nephrectomies and twenty-seven vaginal hysterectomies, the anesthetic proved very satisfactory.

The cost of intravenous pentothal sodium oxygen anesthesia, as noted in Table XI, is no greater than the other general anesthetics when used in institutions with trained, full-time anesthetists and used with equal frequency.

SUMMARY

This study is based on a review of available recent current literature, and on data derived from 837 cases in which a major operation was performed under intravenous pentothal sodium oxygen anesthesia from September 1, 1939, to November 30, 1941.

A discussion of the history, pharmacologic action, indications, advantages, disadvantages, deductions and statistics on this type of anesthesia has been presented, based on the conclusions of other authors and the data in this series. Tables presenting statistical data and figures illustrating the technical points in administration of the anesthetic are also included.

CONCLUSIONS

The following conclusions have been drawn from a study of 837 intravenous pentothal sodium anesthesias supplemented with continuous inhalation of 100 per cent oxygen: (1) The anesthetic was used in only elective major surgical procedures. (2) No patient in shock was operated upon. (3) It is a safe anesthesia that permits muscular relaxation equal to that of spinal anesthesia. (4) There is no explosion hazard. (5) Only trained anesthetists who have adequate equipment at hand should administer the drug (6) The maintenance of an adequate airway at all times is an absolute necessity. (7) The continuous inhalation of a high percentage of oxygen prevents serious complications and death.

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ACUTE CHOLECYSTITIS

CERTAIN PATHOLOGIC AND SURGICAL ASPECTS

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MANY articles dealing with acute cholecystitis have appeared in the literature during recent years. Judd and Phillips, in 1933, reported the results of treatment at the Mayo Clinic of 508 patients who had acute cholecystic disease. Wesson and Montgomery reported on eighty-seven more patients encountered from January, 1934, to July, 1936. The present study was undertaken for the purpose of surveying a more recent group of patients with particular reference to the progress of the pathologic process and the influence this progress might have on the indications for treatment of acute cholecystitis.

Stone and Owings presented an excellent historical review of the subject, in which the advisability of both delayed and early surgical treatment was discussed. More recent contributions include the work of Heuer, McCloskey and Lehman, Fallis and McClure, Fowler, Atlee and Atlee, Edwards and associates, Best, Wallace and Allen, McNealy and others.

SELECTION OF CASES

The present study was limited to cases in which cholecystitis was considered to be acute preoperatively, surgically and pathologically. All cases in which cholecystitis was believed to be either subacute or chronic by the internist, surgeon or pathologist were excluded. We agree with Fallis and McClure that only by restricting cases in such a manner can a true picture of acute cholecystitis, from a clinical point of view, be obtained. The frequent lack of correlation between the pathologic process and the clinical evidence in cases of acute cholecystitis is well known. For example, from July, 1936, to April, 1942, there were found to be recorded 248 cases in which the diagnosis of acute cholecystitis had been made by pathologists (89 per cent of which were also believed by the surgeon to be acute cholecystitis); but none of these had been considered to be acute cholecystitis preoperatively. The mortality rate in this group was 2.8 per cent. By way of contrast, in the present study the condition of 127 patients who had acute cholecystitis treated surgically had been diagnosed as acute cholecystitis preoperatively, surgically and pathologically, with a mortality rate of 6.2 per cent. It is, therefore, at once apparent how confusing various data become unless a uniform classification of acute cholecystitis is employed by all authors.

For the purpose of evaluating the change in the pathologic process of acute cholecystitis in accordance with the duration of the disease, records of the symptoms of these 127 patients were divided into three main groups, namely, *immediate, early* and *delayed*, depending upon the interval between the onset of symptoms and the performance of an operation. The *immediate* group was composed of symptoms of patients on whom operation was performed within seventy-two hours from the onset of symptoms. Thirty-two cases (25 per cent) are included in this group. Symptoms that had persisted for from four to seven days before surgical treatment was undertaken were placed in the *early* group. There were twenty-seven cases (21 per cent) in this group. The remaining sixty-eight patients (54 per cent) had experienced symptoms for more than a week prior to

operation; their symptoms were placed in the *delayed* group.

PATHOLOGIC CHANGES IN RELATIONSHIP TO DURATION OF THE DISEASE

As is well known, there is a gradual progression in the inflammatory process in acute cholecystitis as evidenced by the histologic appearance of gangrene and gross evidence of perforation, as the acute process continues day by day. In the

TABLE I
RELATIONSHIP OF DURATION OF DISEASE TO INCIDENCE OF GANGRENE AND PERFORATION

Time of Operation	Acute Cholecystitis, Cases	Gangrene of Gallbladder, Microscopic Evidence		Perforation of Gallbladder, Surgical Evidence	
		No.	Per Cent	No.	Per Cent
Immediate	32	9	28.1	2	6.2
Early	27	8	29.6	3	11.1
Delayed	68	28	41.1	17	25.0
Total	127	45	35.4	22	17.3

delayed group, 25 per cent of the sixty-eight patients had evidence of local perforation, whereas, only 6.2 per cent of the thirty-two patients in the *immediate* group had such perforation. (Table 1.) It is therefore evident, as had been known previously, that certain advanced conditions such as gangrene and perforation can be avoided frequently by operation within the first few days after the onset of the symptoms of acute cholecystitis. In the entire group of 127 cases, twenty-two gallbladders were found to be perforated at the time of operation. Since the process of perforation usually is gradual enough to permit localization of the inflammatory reaction, generalized peritonitis resulting therefrom is not frequent. There were only two cases in which generalized peritonitis occurred in our series, and in both of these the symptoms were of the *delayed* group.

It seems likely that peritonitis had been present for some time prior to operation in these two cases. It is also observed (Table 1) that the longer operation is delayed after the onset of symptoms, the greater the incidence of microscopic evidence of gangrene of the gallbladder will be. It would seem advisable when possible to avoid late complications of this type by prompt operation.

HEPATITIS AND PANCREATITIS

Hepatitis and pancreatitis commonly are associated with disease of the biliary tract, and a search for evidence of the presence of these conditions was made at the time of surgical exploration in this series of 127 cases. These two diseases were

TABLE II
RELATIONSHIP OF DURATION OF DISEASE TO INCIDENCE OF PANCREATITIS AND HEPATITIS

Time of Operation	Cases, No.	Associated Hepatitis and Pancreatitis	
		No.	Per Cent
Immediate	32	3	9.3
Early	27	2	7.4
Delayed	68	11	16.1
Total	127	16	12.5

found to be present in more than 16 per cent of the sixty-eight cases in which operation had been deferred for more than a week; whereas, less than 10 per cent of the thirty-two patients operated upon within a week of the onset of symptoms had hepatitis and pancreatitis. (Table II.) The clinical importance of these two conditions may vary considerably from case to case. In certain instances one or both of them may be a predominant factor or factors in the patient's illness, but in many instances they are of no great clinical importance.

EASE OF OPERABILITY

The ease with which any operative procedure can be performed is a matter of some importance. In general, operations on the biliary tract which present no particular difficulties probably are associated with a lowered initial risk and an increased probability of an entirely satisfactory ultimate result. This is especially true of operations for acute cholecystitis. If cholecystectomy is especially difficult, the incidence of cholecystostomy may be increased, and although in some cases this

Cholecystectomy usually is readily accomplished when it is performed within the first three days after the onset of the patient's symptoms. If operation is delayed for a longer period, the percentage of cases in which cholecystectomy is performed becomes definitely lower and more patients must be treated by cholecystostomy. (Table III.) There were eight deaths in the

TABLE III
RELATIONSHIP OF DURATION OF DISEASE TO TYPE OF OPERATION PERFORMED

Time of Operation	Acute Cholecystitis, Cases	Operation, Type							
		Cholecystectomy		Cholecystostomy		Partial Removal Gallbladder		Drainage of Abscess	
		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Immediate	32	26	81.2	5	15.6	1	3.1		
Early	27	14	51.8	13	48.1				
Delayed	68	42	61.7	22	32.3	2	2.9	2	2.9
Total	127	82	64.0	40	31.4	3	2.3	2	1.6

factory ultimate result. This is especially true of operations for acute cholecystitis. If cholecystectomy is especially difficult, the incidence of cholecystostomy may be increased, and although in some cases this

TABLE IV
RELATIONSHIP OF DURATION OF DISEASE TO MORTALITY RATE

Time of Operation	Cases, No.	Deaths	Mortality Rate, Per Cent
Immediate	32	2	6.2
Early	27	1	3.7
Delayed	68	5	7.3
Total	127	8	6.2

operation may be definitely indicated, complete removal of the gallbladder generally is desirable if it can be performed without too great a risk. For this reason the ease of operation in the presence of acute cholecystitis is of some importance.

entire series of cases, resulting in a mortality rate of 6.2 per cent. (Table IV.) Two of the three patients with symptoms in the *immediate* and *early* groups who succumbed had been considered preoperatively to be exceedingly poor risks.

COMMENT

The number of cases in the present series is too small to be of statistical value; however, experience based on this group of cases tends to indicate that the mortality rate and the incidence of postoperative complications with reference to the biliary tract are higher when surgical operation is done for acute cholecystitis than they are when it is performed for chronic cholecystitis. In six of the 127 cases reviewed herein there was some type of postoperative complication referable to the region of the gallbladder, such as cholangeitis, persistent drainage of bile or subsequent evidence of stone in the common bile duct. However, in a separate series of 127 con-

secutive cases in which operation had been performed for chronic cholecystitis during the early part of 1941, only one patient had any such complication, and there were no deaths in the series. The number of patients who might succumb from acute cholecystitis or its complications while under continued medical management for this disease cannot be readily determined. There would of course be considerable variation in statistical reports of such cases, depending upon the type of case included in the study.

If operation is to be performed for acute cholecystitis, it would seem preferable to perform it within the first seventy-two hours after the onset of the disease. Otherwise, the incidence of pancreatitis, hepatitis and extensive inflammatory reaction in the biliary tract and surrounding tissues renders operation more hazardous and more difficult and increases the likelihood of undesirable postoperative sequelae. If operation is not performed within this period, it would appear desirable if possible to postpone it until the acute process has largely subsided—usually a matter of three weeks or more. Indications for treatment should of course be decided for each patient.

SUMMARY AND CONCLUSIONS

Records of 127 patients who had cholecystitis which was diagnosed as acute by the internist, surgeon and pathologist, encountered from July, 1936, to April, 1942, have been reviewed.

It was observed that the incidence of gangrene and perforation increased as the duration of the disease increased. The same was true for the incidence of asso-

ciated hepatitis and pancreatitis. The feasibility of performance of cholecystectomy in contrast to the feasibility of performance of cholecystostomy was greater within the first seventy-two hours after the onset of acute cholecystitis than at any subsequent time prior to subsidence of the acute process. Various complicating features associated with the surgical treatment of cholecystitis are more likely to occur when operation is performed for acute cholecystitis than when operation is performed for chronic cholecystitis.

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FIVE YEARS' EXPERIENCE WITH HEMO-IRRADIATION ACCORDING TO THE KNOTT TECHNIC

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IN May, 1940, the author published a report[20] on this method in 110 cases which he had treated in a period of about eighteen months. The material represented twenty-nine different conditions. Since that time other investigators have published a number of papers on the subject, the total, with the present paper amounting to fourteen. The writer has treated over 400 persons with this method during the last five years, and the present article sets forth some of the interesting findings which he and other workers have observed in connection with this radical departure from conventional methods of ultraviolet therapy. Nine illustrative cases are presented.

A comparison with the older methods is natural and inevitable. The ultraviolet radiologist has long recognized the difficulties attending the administration of this form of radiant energy arising from the great variability in important factors. The skin, it is hardly necessary to point out, offers a considerable problem by virtue of the variations met with, such as thickness, natural color and pigmentation, degrees of hematization, etc. In addition to these factors there are the inherent faults of the skin as a receptor for ultraviolet radiation, as for example the variation in sensitivity and its susceptibility to radiation injury. Notwithstanding these natural handicaps which interfere with efforts to utilize the skin as a medium for the absorption of ultraviolet energy, much has been accomplished in using it in the therapy of numerous conditions.

Some of the achievements of ultraviolet ray therapy in infections prior to hemo-irradiation are: *Lupus vulgaris,* a tuberculous disease of the skin and membranes was first successfully treated by Neils Finsen[4] with a special arc lamp of his design as long ago as 1897. Up to the year 1910, at the Finsen Institute in Copenhagen, Finsen and his successors had treated 2,000 patients with a recovery of 98 per cent. We still have lupus vulgaris with us. The author saw a case recently in which the greater part of the skin of the face was covered with the lesions; one eye had been invaded, the sight destroyed and the lids of the other were involved. Strangely, no one had used the Finsen technic or even a modification of it.

Extrapulmonary tuberculosis or surgical tuberculosis of bones, joints, peritoneum, etc., is another field in which ultraviolet radiation is pre-eminent. Dr. Cecil Rowntree,[33] Hunterian Professor of Surgery, Royal College of Surgeons, asserts, "The treatment of tuberculous disease of the bones has fortunately undergone a revolution in recent years for the drastic and crippling operations are now replaced by a regime which includes complete rest of the affected part and very conservative and limited surgical operation for the purpose of evacuating abscesses combined with sunlight treatment, real or artificial. When persevered with, such methods almost always effect a cure in every case."

Erysipelas. A few physicians employed ultraviolet radiation for this condition in the 1920's with success and Walter H. Ude, Radiologist to the Minneapolis General Hospital, reported a series of 100 cases in 1929, claiming for ultraviolet energy practically specific action in his series. This was substantiated by an increasing number of observers and the agent came into general

use during the next decade. It has been largely eclipsed by the introduction of the sulfa drugs which are easier to administer.

These examples of the effectiveness of ultraviolet radiation therapy—in the hands of competent therapists—are cited to give some indication of the potency of this form of radiant energy. The same kind of spectral energy is employed in the Knott technic, in a very different manner, however, from conventional methods.

With the Knott technic there is very little variability in the important factors involved. A definite amount of blood is removed from a vein, citrated and immediately returned to the blood stream via the Knott hemo-irradiator which consists essentially of a pump, an ingeniously designed irradiation chamber, a water-cooled mercury quartz lamp and a mechanism for controlling the rate of flow of the blood through the circuit and consequently the irradiation time. Accurate dosage, the one outstanding factor in the effectiveness of ultraviolet radiation therapy, is finally achieved in this manner. There had been much reason to believe before Knott's work that the most important element concerned in ultraviolet radiation therapy was the blood; but a practical and efficient direct method had not been devised, as far as the author is aware, until Knott and his associates evolved the method of treating the blood that is proving so valuable in the treatment of infections and other conditions.

One of the most celebrated authorities on immunology, Sir Almroth Wright,[9] (originator of the system of therapeutic innoculation for bacterial infection and of methods for measuring the protective substances in the blood) in his article on Immunology in the fourteenth edition of the Encyclopedia Britannica states as follows, "As has been shown in the irradiation of the skin with ultra-violet light, the light of the electric arc and sunlight that by these agencies also the bactericidal power of the blood is increased, such bactericidal power depending upon the increased phagocytic power of the leucocytes and also upon the increased antibacterial power of the serum. It is not yet known how irradiation produces these results. Increased bactericidal power is achieved only with certain quanta of irradiation and the blood suffers deterioration when larger doses are employed."

Other recognized authorities have similarly expressed themselves as for example Sir Henry Gauvain,[12] Sir Leonard Hill,[10] Sir Walter S. Lazarus Barlow[11] et al.[13]

There has been a good deal of investigation into the effect of ultraviolet energy on various constituents of the blood, normal and abnormal (bacteria, toxins, etc.). Other writers on hemo-irradiation have given some of the important references in their bibliographies.

To those bacteriologists and others whose experience with ultraviolet energy has been largely confined to experiments consisting in the exposure of petrie dish cultures to various sources of ultraviolet radiation and to x-rays, it is only fair to point out something that has apparently escaped many such an investigator, namely, the vast difference between inert gelatine and living reacting animal tissues.

The problem presented by the Knott technic is this: Granted for sake of argument that bacteria are readily killed under certain conditions by ultraviolet energy, granted also that they are killed if present in the blood of a patient when some of this blood passes through the irradiation chamber, and that toxins are inactivated also,[16,17,18] how is one to explain the apparent effects on the balance of the blood not treated ($\frac{15}{16}$ to $\frac{19}{20}$ of the blood volume)? It has been suggested that the irradiated portion carries the primary ultraviolet rays into the untreated portion of the blood and that secondary radiation is produced in this; but the author cannot entertain this theory from the point of view of the radiologist with any great enthusiasm. The initiation of chain photochemical reactions in the irradiated blood continued and in the unirradiated portion is probably the basis of the action. When we consider first of all

the complexity of even the most simple photochemical processes and then reflect on the very complicated character of blood consisting as it does of serum, red and white cells, platelets, chylomicrons, antigens and antibodies, hormones, endocrine substances, enzymes, iron, phosphorus, calcium, and various pathogenic substances at times, bacteria, bacterial and other toxins, etc., it seems somewhat fool-hardy to undertake to say just what happens under the influence of ultraviolet radiation although it may be said in truth that some things are known and we have clues about others.

PHYSIOLOGICAL EFFECTS FOLLOWING HEMO-IRRADIATION IN INFECTIONS AND TOXEMIAS

1. *Reduction in Toxemia.*[5] (Cases I–X.) This is demonstrated subjectively by improvement in the mental state and clarity of thinking and speaking which may take place within a few minutes following hemo-irradiation. By the following day reduction in toxemia is usually very noticeable, associated with an improvement in the sense of well being. Objectively, it is indicated by fall in temperature, diminution in the sedimentation time and improvement in the blood picture.

2. *Improvement in the Blood Picture.* There is a marked tendency for a restoration to normal levels of the various blood elements. With the reduction in the infective process there is a fall in the white count, with an increase in the young white cells. If the count has been low, due to poor response to the infection, it is frequently raised to an appropriate level for the severity of the infection. When leucopenia has been caused by certain drugs this is nearly always corrected. In the case of a secondary anemia, due to the two influences, destruction of red cells and inhibition of the red cell forming mechanism, there is a return to normal levels within a relatively short time. It will be noticed that some of the patients have received blood transfusions which may in some cases give a temporary

boost to the red cells; but if the infection continues, this gain may be only transient. With a reduction of the toxemia following one or more hemo-irradiations, it is only natural that the blood picture should improve. That is one of the most consistent effects, and it is seen also uniformly in the less severe infections and in debilitated persons. The same effect is witnessed in the case of the hemoglobin. It is highly desirable to give patients blood transfusions and glucose when the blood is in serious condition and a prompt effect is imperative. There is no objection to transfusions and the records show that we have supplemented hemo-irradiation with these on numerous occasions. Every aid in desperate cases should be employed, but what we do wish to emphasize is the fact that many of our seriously ill patients have already had one or more transfusions (Case IV had seven), and these and other measures failing, hemo-irradiation was resorted to.

3. *Improvement in the Peripheral Circulation.* We have witnessed a great many times in cyanotic individuals a return to natural color even during the giving of the hemo-irradiation. In the case of the young woman with bronchopneumonia (Case VI) this was evident while she was still in the oxygen tent and receiving oxygen which was being given almost constantly, long before hemo-irradiation was contemplated. This change in color is due to an increase in the venous oxygen.[22] The improvement in the temperature of the extremities and the sense of warmth that patients remark about is a very common effect associated with hemo-irradiation. Patients volunteer this information, and the improvement in the circulation in the hands and feet is maintained indefinitely. In some cases it may last for only a few days to be restored after a second irradiation, or it may persist for months or longer.

4. *Relief of Pain.* One of the most interesting effects is early relief of pain. This may take place even while the treatment, which takes only seven to twelve

minutes, is in progress. At first the author believed that it was a psychological effect but it has occurred so many times, that is, the practically immediate relief, that it can no longer be explained on this basis. Within twenty-four hours relief is very common.

5. *Improvement in the Appetite.* (Cases II, V, VIII.) This is frequently a striking effect. There is cessation of nausea and a return of appetite taking place sometimes in twelve to twenty-four hours. This is commonly associated with a return to normal weight. Several of the cases described indicate the marked effect on the appetite and weight. The case of peritonitis (Case V) had a real zest for food in twelve hours. She gained fifteen pounds in fourteen days and twenty-six pounds in twenty-one. The patient with toxemia and debility (Case II) following eclampsia gained thirty-six pounds in seven weeks. The patient with superior inferior cerebellar artery thrombosis (Case IX) was forty-five pounds under normal weight when first seen and irradiated. He began immediately to gain, recovered forty-five pounds in about four months, and continued to gain so that in nine months he had put on fifty-five pounds.

Best results are obtained in infections in which the blood supply is good or moderately good, that is, in which the infection is not walled off to such an extent that the irradiated blood cannot enter the focus, as for instance in the case of an abscessed tooth. Toxemia and arthritis due to an abscessed tooth will be temporarily reduced, but in due course they will return if the tooth is not removed. It is desirable when several teeth are infected to irradiate the patient before extraction (Case VIII), and this can then be done safely at one time without fear of aggravating an associated arthritis or of producing a bacteremia. Healing of the sockets and gums is increased in rate if hemo-irradiation is given before or shortly after extraction.

Attention is called to the findings of Dr. E. W. Rebbeck in septic abortions.[30] He found that preoperative hemo-irradiation

diminished postoperative temperatures, and in none of the cases in which operation was done after hemo-irradiation did a transient bacteremia develop, but in some cases in which a dilatation and curettage were done without preoperative irradiation transient bacteremias did appear.

In peritonitis in which the blood circulation is good and in cellulitis the results are excellent. It is desirable, of course, to remove a focus of infection or drain surgically. We always urge that, but to repeat, it is a very excellent practice to give preoperative hemo-irradiation especially in severe cases of infection to insure a good postoperative convalescence with a minimum of discomfort and to prevent complications.

RESULTS OF HEMO-IRRADIATION IN INFECTIONS

1. E. K. Knott and V. K. Hancock reported the recovery of two apparently moribund patients in 1934, one a septicemia and the other a brain abscess.

2. H. A. Barrett reported 110 cases in 1940, including a number of infections. Twenty-nine different conditions are represented in this series. Among the conditions treated were the following: infectious arthritis, thirteen cases; osteo-arthritis, sixteen; tuberculosis glands, two; chronic blepharitis, four; mastoiditis, two; uveitis, one; furunculosis, three; chronic paranasal sinusitis, four; acne vulgaris, three; secondary anemias, eight. The results were very encouraging.

3. In a series of 151 consecutive unselected cases of acute pyogenic infections treated by George Miley at Hahnemann Hospital, Philadelphia, between November 1, 1938 and December 31, 1941, the recovery rate was 100 per cent in the early cases; in the moderately advanced eighty-one cases the rate was 98 per cent and in fifty-five apparently moribund patients the rate was 42 per cent. The series included eighteen cases of puerperal sepsis with eighteen recoveries; septic abortions, nineteen cases with seventeen recoveries; gen-

eralized peritonitis, seven cases with seven recoveries; four femoral thrombophlebitis cases with four recoveries, and seven pelvic abscess with pelvic peritonitis cases with seven recoveries. Of the 151 cases, fifty-seven were obvious chemotherapeutic failures. In the fifty-five apparently moribund patients there were twenty-six who received combined hemo-irradiation, and of these nine had bacterial endocarditis and seven had Staphylococcus aureus septicemia. If all the cases of bacterial endocarditis and Staphylococcus aureus septicemia are excluded, there are a total of thirty-one recoveries among forty-one cases of obvious chemotherapeutic failure which is about 75 per cent.

4. E. W. Rebbeck reported on ultra-irradiation of blood in the treatment of puerperal sepsis. Between July, 1937, and May, 1940, thirteen patients were treated with hemo-irradiation all of which recovered. There were six sulfa drug failures in this group. One patient showed non-hemolytic streptococcic positive blood cultures. All patients with puerperal sepsis now receive hemo-irradiation at Shadyside Hospital.

5. E. W. Rebbeck also reported on septic abortions. From July, 1938, to June, 1941, sixteen patients were treated in Shadyside Hospital, Pittsburgh, twelve preoperatively and four postoperatively. Of these seven were in a state of advanced morbidity when admitted and one had an indifferent streptococcus in the blood stream. In those instances in which this therapy was used postoperatively (in four cases with advanced morbidity) prompt relief of toxemia and decrease in fever were outstanding. Three patients had been given sulfanilamide. All the patients recovered.

6. Virgil K. Hancock reported four cases of hemolytic streptococcus blood stream infections, one colon blood stream with a temperature of 108.4°F. and a Staphylococcus albus blood stream infection complicated by osteomyelitis and broncho-pneumonia. These patients were treated between 1933 and 1938. The total number

of treatments was seventeen or an average of 23¾. He reported in the same paper five cases of Streptococcus viridans infection of the blood stream, three patients with endocarditis, all dying, and two without endocarditis who recovered.

7. Miley reported thirteen consecutive cases of acute thrombophlebitis with thirteen recoveries. In all thirteen cases a rapid disappearance of pain and tenderness was observed, usually within twenty-four to forty-eight hours. Five of the cases were chemotherapy failures. Edema subsided in twelve cases, the disappearance time varying from three to fifteen days. Local heat and bed-rest elevation of the extremity had been tried without success in a number of cases.

CASE REPORTS

CASE I. Infectious arthritis with uncontrollable perspiring. Physician, Dr. Hunter, Flushing, N. Y.

The patient had rheumatic fever in 1933 which left her joints so painful she could scarcely walk, for a month or so. Then she seemed to recover completely except for her heart which was temporarily affected but she seemed to recover from this after a time.

However, during the winter of 1937 to 1938 she developed a myocarditis and endocarditis. She had very severe night sweats and her weight fell off considerably to seventy pounds. A month before coming to me for an irradiation she had had a tooth extracted and a culture showed Streptococcus hemolyticus.

At the time of hemo-irradiation the patient looked weak and ill. She had been sent to me to see if irradiations would have any effect on the uncontrolled night sweats. She had been under several physicians for this, but no definite cause was found and all medication failed. The patient stated that she had to remove or change the bed linen three and four times nightly summer and winter. She had in addition to this polyarthritis which was moderately severe, but it was because of the sweating she had come to the author.

The patient was given five irradiations in all. The first treatment was given on a Saturday, June 24, 1938. On Sunday morning the patient phoned to say that she had perspired only about half the usual amount and that she felt

better. The perspiring diminished still more the following night and became progressively less. When she came for her second irradiation for a period of three months, her health was in a wretched state. She was weak, lacked an appetite, and could not regain her lost weight,
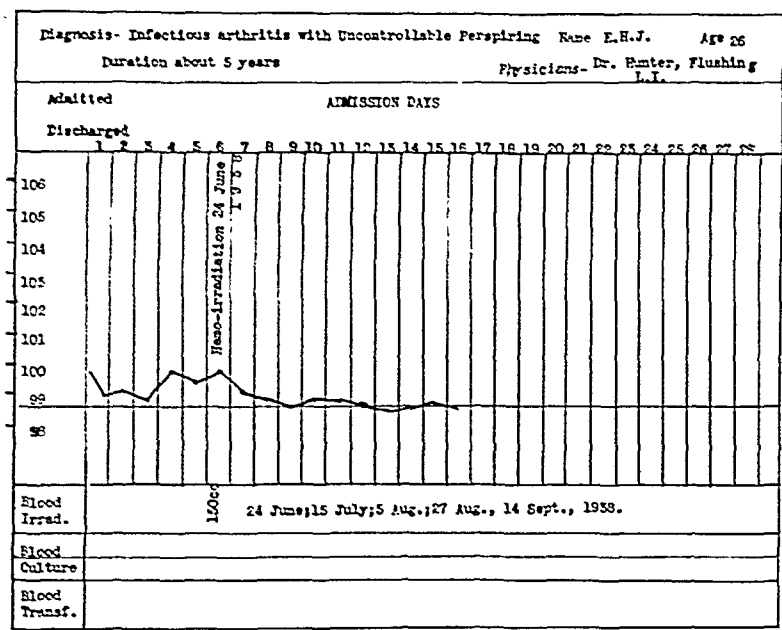

FIG. 1. Case I.

on the 15th of July, she was generally much improved, although the sweating was increasing somewhat. The second and subsequent irradiations were very effective, and following the third she was completely over her sweating and it never returned.

The patient was heard from through her husband for several months after her last treatment, and there has been no return either of the perspiring or of the arthritis.

CASE II. Toxemia of pregnancy and post-eclampsia.

A white female, aged twenty-three, became pregnant about November 15, 1937. Shortly after this she developed nausea and vomiting, and for about three weeks she could barely keep anything but water and fruit juices on her stomach. She lost about twenty-four pounds in weight in a period of about six weeks. She was very weak and her skin was covered with a great number of small pimples. She then started to improve, but at no time did she feel like herself. At six and one-half months she had a sudden eclamptic seizure after complaining of a headache the morning of the attack. At the hospital she was placed on the Stroganoff sedation therapy to which she responded fairly well. However, in a week's time the fetal heart sounds ceased and the fetus was removed. Following her return home,

her weight being only one hundred six (normal one hundred twenty-eight). It was decided to give her a hemo-irradiation and this was followed by a remarkable improvement in her health. She gained thirty-six pounds in seven weeks.

After an interval of two years, she became pregnant a second time, but again she became very toxic and started to lose weight quickly. An irradiation was given with a very prompt improvement in her health and strength. Another irradiation was given in ten days followed by a third in ten days. She was given a prophylactic hemo-irradiation seven days and another seven hours before being delivered of a healthy child. A few weeks ago she became pregnant for a third time, and soon after started vomiting and appeared to be about to have a repetition of previous toxemias. This time hemo-irradiation was given at once followed by a second in two weeks, and at the present time she enjoys much better health than in the earlier weeks of her previous pregnancies. She is maintaining her weight and has no signs of nausea or evidence of toxemia.

Various writers have reported on the value of ultraviolet radiation in the toxemias of pregnancy and in pre-eclamptic states. Hochenbichler treated 100 patients

in which there was acidosis by ultraviolet radiation and even after the onset of convulsions and treated in the early stages

Examination revealed a pinkish purulent discharge in the vagina originating from the endocervix. The cervix was slightly soft, not
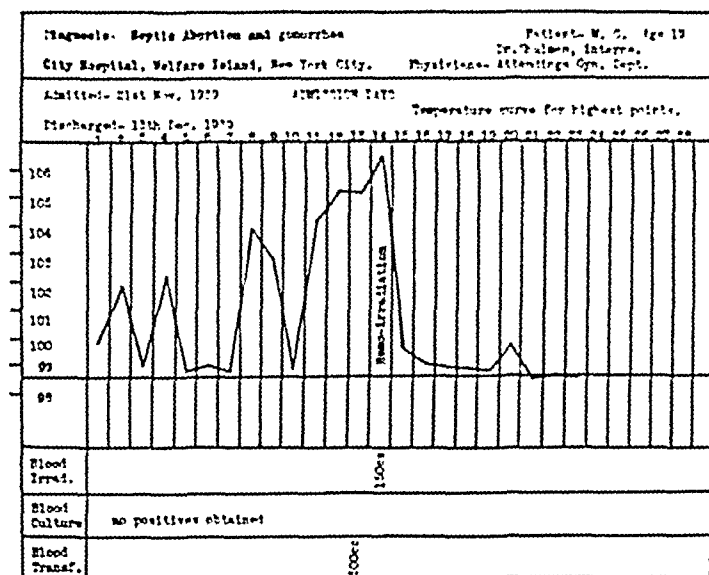

FIG. 2. Case III.

none developed serious complications. In Case II, there is no question of the marked benefit to the health following irradiations on three separate occasions associated with three pregnancies, in the same individual. No claim is made for hemo-irradiation for toxemias of pregnancy on the basis of this one case, but the author believes the method deserves further investigation in this class of toxemias.

CASE III.   Abortion followed by sepsis.* Chemotherapy failure.

A nineteen year old white female was admitted for vaginal bleeding on November 21, 1939. She stated that in February, 1939, she was delivered of a seven month's living premature infant by forceps. Her first menstrual period returned on October 12th and lasted one and one-half days. Following that period she thought she was pregnant, so she pushed her finger into her uterus on November 12th and began bleeding with passage of clots. She continued bleeding until admission. On the morning of admission she had a chill. She appeared acutely ill. Her temperature was 100°F., pulse 104, respirations 24.

* History of case taken from hospital records of City Hospital, Welfare Island.

patulous. It was retrodisplaced, normal in size, the adnexa was not outlined but there was a sensation of masses in both regions. Her temperature ranged between 99 and 102.6°F. for the first two days. Cervical and urethral smears were positive for gonococcus and the patient was placed on sulfanilamide on November 25th. Her temperature remained at 99°F. for three days but on November 28th after she had received 180 gr. of sulfanilamide she became cyanotic and had a chill with a temperature of 103.6°F., so this drug was discontinued. The patient then began running a septic temperature up to 105.6°F. Seventy gr. of sulfanilamide were given on December 2nd and again discontinued.

On December 3rd the patient was given a 500 cc. blood transfusion. Her temperature on December 4th at 2:30 P.M. was 106.4°F. following a chill. All blood cultures were negative.

Hemo-irradiation was ordered and 130 cc. of the patient's blood was irradiated and reinjected. The temperature fell by crisis on the following day and remained normal except for a rise to 100°F. on December 10th which promptly returned to normal. A catherized urine examination on December 28th was negative. Constant blood studies were made and on discharge, all studies were found normal.

CASE IV. Septic abortion with pelvic abscess and peritonitis. Chemotherapy failure.*

M. L., a twenty-nine year old white female was admitted on October 16th with the following history: Her last menstrual period was on July 26th. Two weeks prior to admission she took twelve ergot pills followed by mustard baths. The following day she began to bleed vaginally passing foul smelling blood clots. Bleeding and passage of clots continued. Two days before admission she had chills, fever, malaise and weakness of arms and legs. The patient was a para III, grava V. She had a seven-months fetus which died at birth. Her menstrual history, past history and system review were negative.

Physical examination on admission revealed an acutely ill patient. Her temperature was 100°F., pulse 112, respirations 24, blood pressure 112/76. The abdomen was soft with tenderness in both parametrial regions. Pelvic examination revealed the vagina to be filled with blood clots and placental tissue; the uterus was enlarged to the size of a three month's pregnancy; it was soft and boggy; the cervix was soft and admitted the tip of finger; the adnexa was tender bilaterally and a brawny mass was attached to the left side of the uterus. The patient had a swollen, tense and tender right olecranon and knee. A diagnosis of septic incomplete abortion was made. A D and C was done on October 18th and about 2 ounces of necrotic foul endometrium was obtained. The patient was put on sulfanilamide on admission. Following curettage the temperature became septic, striking between 101 and 104°F. Transfusions were given. The joint complaints had subsided by October 28th, but the temperature continued septic. Examination on October 31st revealed an extremely tender soft mass to the right of the uterus. On November 4th examination showed abscess of the right broad ligament. The patient was taken to surgery and a colpotomy done. About ½ ounce of frank pus and some cheesy material was discharged. A large tube was inserted for drainage. The temperature peak was 103°F.

On November 5th, 190 cc. of patient's blood was irradiated and re-injected. On the following day the temperature dropped to 101°F. and for the next few days it ranged between 99 to 100°F. On November 11th examination revealed a

* History of case taken from hospital records, City Hospital, Welfare Island.

large tender mass in the left lower quadrant and the temperature rose to 101°F.; 150 cc. of patient's blood was again irradiated and re-injected. Her temperature began falling slightly but on November 13th a transfusion was given and the patient had a reaction with temperature rising to 105°F. Blood cultures were negative but on delayed growth was called Bacillus coli. The day following the transfusion reaction, the patient became jaundiced with an icteric index of 55. On November 17th the icterus began to subside and temperature became lower—between 99 to 102°F. On November 24th the colpotomy tube was removed, temperature began to flatten out and by November 27th it reached normal and remained so. However, examination on November 25th revealed the large tender mass in the left side extending almost to the level of umbilicus. By December 2nd the left adnexal mass had decreased some in size and tenderness

Examination on December 12th revealed the right adnexal thickened, the uterus pulled to the right, normal in size, and a tender cystic mass in front and to the left of the uterus. The last examination made on December 16th revealed findings as above but the mass had decreased in size to three fingers above the symphysis on the left and a diagnosis of subsiding postabortal salpingitis was made. Catheterized urine examinations had been negative throughout. Hematological examination on admission showed 70 per cent hemoglobin and 23,000 white blood cells. Hemoglobin never fell below 60 per cent and a complete blood count on November 24th revealed 4.14 red blood cells with 72 per cent hemoglobin, totaling 2,950 cc. of citrated whole blood. Electrocardiograms were normal. Pelvic diathermy begun on November 30th was continued for ten days. The patient was discharged well. Follow-up clinic records show that the patient recovered from all intrapelvic disturbances, the uterus was free and moveable and there were no masses in the adnexae.

CASE V. Peritonitis due to nonhemolytic staphylococcus aureus. (Patient of Dr. E. D. 140 E. 54th Street, N. Y. C.) E. M. Chemotherapy failure.

E. M., was admitted on September 19, 1941 because of pain on defecation, metrorrhagia and tender pelvic mass. She had been operated upon in 1938 for ruptured appendix but had been in bad health ever since. Operative find-

ings were bilateral pyosalpinx with cystic degeneration of the right ovary, myoma uteri and chronic pelvic peritonitis. The patient did

twelve days previously and when seen by me she was in an oxygen tent. Several films of the chest were examined and they disclosed the
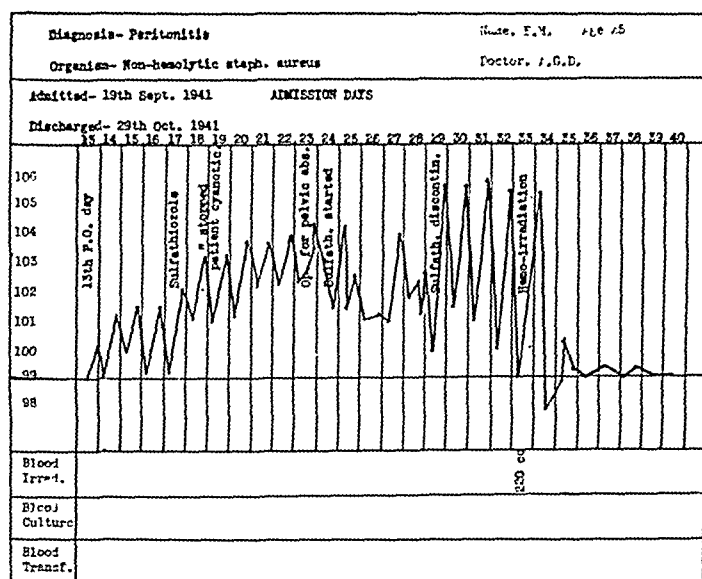

FIG. 3. Case v.

well until the fourteenth postoperative day when she developed pain in the pelvis and started to run a temperature. Diagnosis of pelvic abscess was made and sulfathiazole was started, but discontinued the next day because of cyanosis. Ten days later a large abscess cavity containing 300 cc. of white nonodorous pus was evacuated from the region of an old appendix stump. Sulfathiazole was started again and the patient apparently tolerated it well this time. But on September 20th the temperature was still up to 105°F. and as there was a suspicion that this was due to the sulfathiazole a blood sulfa level was done which showed only a faint trace of the drug. The drug was discontinued but the temperature still continued. Two days later the patient was given a hemo-irradiation and in twenty-eight hours was well, headache was gone, temperature was normal, appetite was excellent, she had no aches or pains and the draining sinuses healed and closed rapidly. The patient put on fifteen pounds in fourteen days, twenty-six pounds in twenty-one and thirty pounds in sixty days. She has remained in excellent health for the last one and one-half years.

CASE VI. Bronchopneumonia; chemotherapy failure.

I was called to treat a twenty-five year old female, a relative of a physician, suffering from bronchopneumonia. She had been taken ill

characteristic shadows of bronchopneumonia. The patient in spite of oxygen therapy was moderately cyanotic. She was not responding to sulfa drug therapy and her white cell count was 9,000 in spite of a severe infection. Her physician and three consultants regarded the case as hopeless, and hemo-irradiation was requested as a last resort. The temperature ranged from 99 to 102°F. but had been higher. However, due to lack of resistance as indicated by the low white count and the patient's general condition, her temperature had remained relatively low (99–101°F.) for several days prior to my first visit.

The usual dosage was employed in this case, and I requested that the oxygen be cut down considerably following the irradiation, for we have found that even before an irradiation is completed, the color usually improves due to greater oxygen absorption. It is no uncommon experience to see the patient with cyanosis become pink before the irradiation is completed. The following day this patient was receiving no oxygen. She was much stronger, and was sitting up. She convalesced satisfactorily, having received only one hemo-irradiation.

CASE VII. Infectious arthritis with severe toxemia; chemotherapy failure.

A. K., a male chief tool and die maker for a naval ordnance plant, became ill about No-

vember 30, 1941, with severe pains and swelling in his left wrist. He was removed to a hospital where eighteen teeth were extracted. In spite of this, his wrist became more swollen and painful. He remained in the hospital for fourteen days during which time he lost sixteen pounds. His physician requested hemo-irradiation as he was gradually getting worse, and when treated by me on December 17th he was very toxic, his hand greatly swollen, was in a sling and he could bear no one to touch it. His sedimentation rate was 120 mm. in sixty minutes. Within an hour after the irradiation he could move his fingers and permit examination of the hand and wrist. The following day his appetite returned, he was obviously much less toxic and much stronger. He had a second irradiation on the 19th at which time his sedimentation rate had fallen to 60 mm. He returned to work on December 22nd, having gained seven pounds in six days, and has been well since.

CASE VIII. Thrombosis of the superior inferior cerebellar artery, bronchopneumonia, pyemia, embolization of the lungs, left femoral thrombophlebitis, paralysis of the left side of body and left vocal cord.[21]

In January, 1940, the author was called to Miami to treat the brother-in-law of a New York physician for a severe toxemia. He had become ill with severe pains in his right shoulder accompanied by intermittent elevation of temperature. He was admitted to a local hospital where in a day or so a swelling appeared in the clavicular region, and soon extended to the right side of the neck. He developed pyemia with embolization of the lungs and bronchopneumonia. Flaccid paralysis of the left side of the face and paralysis of the left vocal cord developed. He coughed with great productivity, there was choking and food was vomited. He became delirious and irrational. When seen by me he had taken nothing but coca cola for eleven days. He had lost forty-five pounds in weight and was in an oxygen tent. His brother-in-law had employed autohemic therapy some days previously without response. I had the man transferred to the Miami Beach Hospital where hemo-irradiation was instituted. There was an immediate response to the first treatment, and a second was given in three days with more improvement. Returning to New York, I was called a second time to Miami, for there had been a slight elevation of temperature. Four days

after this the patient was brought to New York and admitted to the Manhattan Eye, Ear and Throat Hospital and placed under the care of Dr. A. Cinelli. He remained there six weeks, when his improvement justified his removal to his home, where in the course of several months he made a complete recovery, and when last seen in December, 1941, he had gained back his lost forty-five pounds and had added ten more. He showed no sign of his serious illness.

The case is not presented in full for lack of space, but it is reported to draw attention to the practically hopeless condition of a patient suffering from what was discovered in New York to be a thrombosis of the superior inferior cerebellar artery with a number of severe complications. The hemo-irradiation was given in the hope of controling the marked toxemia—he had on a number of occasions a sediment rate of 120—and also to build up his resistance. During the hospitalization in New York, he developed a thrombosis of the femoral vein on the left side accompanied by rise of temperature and very severe pain. Various measures were used without avail, but after an irradiation there was a prompt response and this complication disappeared in two or three days. In all, this patient was given nine hemo-irradiations, three in Miami, three at the Manhattan Eye, Ear and Throat Hospital, and three after he returned home. During his convalescence at home, it was discovered that he had a toxic goiter which accounted for the continued elevation of the pulse rate. This condition was treated by radium with very satisfactory results.

CASE IX. Staphylococcus pyogenes aureus blood stream infection and foot-drop following the administration of sulfametathiazol. Chemotherapy failure.

A white unmarried woman, aged twenty-eight, had a chill followed by fever on May 11, 1940. No cause was discovered but as her fever continued she was admitted by her physician, Dr. Carl Zoll, to Wickersham Hospital, New York, on May 14th. At this time she was not acutely ill and did not complain of headache or pain of any kind, only a feeling of malaise. Her temperature on admission was 102.6°F. Two days later a blood culture was reported positive for Staphylococcus aureus. She was placed on neo-prontosil and under this her temperature gradually fell. For reasons not disclosed by her hospital chart, she was dis-

charged from the hospital June 10th. Her temperature was about normal, but she had a positive culture the day of discharge and she also had a secondary anemia of moderate degree.

Two days later she was re-admitted with a temperature of 100.6°F. and the same day was given a 500 cc. blood transfusion, and prontosil was continued. Her temperature fluctuated between 97 and 99°F. and she had a number of negative cultures, but also three positives. On July 12th, it was decided to discontinue the neo-prontosil and try sulfamethathiazol, but the positive cultures continued and in a few days she developed foot-drop.

As the patient was making no real progress, the sulfa drugs having failed to clear up the blood stream infection and also because of the footdrop, sulfametathiazol was discontinued and Dr. Zoll requested me to give his patient an irradiation of her blood by means of the Knott technic. The amount of blood treated was 210 cc. Six days later a blood culture was returned positive. Meanwhile thiamin chloride was instituted for the foot-drop. A second hemo-irradiation was given eleven days later together with a blood transfusion of 300 cc. This was her third blood transfusion and her second hemo-irradiation. It is only fair to point out that the 3rd blood transfusion given with the second hemo-irradiation may have played a role in clearing up the secondary anemia, although the two previous blood transfusions had not been followed by any improvement.

Three hemo-irradiations were given after the patient left the hospital to prevent any possibility of relapse. The only medication received after the first hemo-irradiation was thiamin chloride for the foot-drop. This condition cleared up very rapidly under this therapy.

SUMMARY

The author in a five-year period (February 16, 1938 to February 16, 1943) has treated over 400 patients suffering from a variety of conditions, infections of various kinds, systemic and regional, including the eye. He has used the method in about thirty cases of asthma and in about sixty cases of arthritis, rheumatoid, infectious and osteoarthritis. In all about thirty-five different conditions have been treated.

Long before the Knott technic of hemo-irradiation was introduced, ultraviolet spectral energy had proved to be a therapeutic agent of preeminence in a variety of conditions: rickets, infantile tetany, extrapulmonary tuberculosis, erysipelas, lupus vulgaris, various skin conditions, certain diseases of the eye (Duke-Elder[3]), et cetera.

By the Knott technic the scope of therapeutic usefulness of ultraviolet radiation has been considerably increased so as now to include bacteremias, toxemias, peritonitis, thrombophlebitis and other serious infective conditions in which the operator can now anticipate prompt and effective action even when sulfa drug therapy and ordinary transfusions fail.

It is a method which raises the general resistance of the individual, diminishes toxemia rapidly and stimulates the healing forces of the body.

It is a safe method with no untoward reactions. It can be used to supplement other recognized measures, operative and medical, but in its own right it is a measure which will often effect a cure when all other therapy has failed.

Nine illustrative cases are offered as evidence of the unusual therapeutic properties of this new method of employing ultraviolet radiant energy with precision apparatus which overcomes most of the uncontrollable factors which have hitherto made the administration of this energy uncertain even in the hands of skilled operators; and it makes possible the treatment of serious infections heretofore not amenable to conventional ultraviolet radiation therapy.

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PHLEGMONOUS CECITIS*

REPORT OF TWO CASES AND REVIEW OF THE LITERATURE

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INTRINSIC inflammatory disease of the large intestine resulting in a phlegmon is a relatively uncommon disease. It is the purpose of this paper to report two cases of phlegmonous cecitis and to review the literature. Although this condition is similar to phlegmonous inflammation of other parts of the gastro-intestinal tract, it presents special problems because of its localization in the cecum. Phlegmonous inflammation of the cecum secondary to appendicitis or diverticulitis will be excluded from this paper.

HISTORY

Phlegmonous inflammation of the gastro-intestinal tract was first mentioned by Galen who described its occurrence in the stomach. Finsterer[1] in his study of phlegmonous gastritis cited Sand who described the first authentic case of circumscribed phelgmon of the stomach in 1700, and the first case of diffuse phlegmon of the stomach discovered accidentally at autopsy by Andral in 1829.

In 1842, Rokitansky[2] described phlegmon of the small intestine which he named enteritis phlegmonosa. The first indisputable case of phlegmon of the large intestine was reported by Goldschmidt[3] in 1887.

DEFINITION

Phlegmonous cecitis is a suppurative inflammation of the cecal wall, beginning as a cellulitis of the submucosa, and terminating in a circumscribed or a diffuse inflammation.

ETIOLOGY

From the nature of the disease, it is reasonable to assume that phlegmonous cecitis is caused by bacterial infection.

Bacteriological studies of this condition are very scant in the literature, but where they were carried out, the predominant organisms found were streptococci and staphylococci, alone, or in combination. Bacillus coli and pneumococci were also mentioned as causative agents. Ingier[4] and Leuchtenberger[5] each reported a case of pneumococcic sepsis with metastatic phlegmonous cecitis in which pneumococci were recovered from the wall of the cecum.

The portal of entry for the offending organism may be either enterogenous or hematogenous. The former is by far the more common way. There are certain etiological factors which permit enterogenous infection. Dowd[6] mentions superficial mucosal abrasions and Bsteh,[7] Cordes[8] and others believe that these may be caused by hard fecal masses. All these authors agree that these abrasions may allow entry of the infecting organisms. Sauer[9] and Szabó[10] report cases in which Trichocephalus dispar and Oxyuris vermicularis were found, and are of the opinion that these worms injured the intestinal mucosa sufficiently to permit entry of bacteria. Cecum mobile and consequent distention and venous stasis are thought by Köntzey and Jáki[11] to be contributory factors. Foreign bodies, such as fragments of bones and fruit stones may also abrade the mucosa in the opinion of Roman,[12] Pich,[13] and Hellström.[14]

The hematogenous mode of infection is mentioned in the literature by Bsteh, Ingier, Leuchtenberger, and Müller.[15]

PATHOLOGY

Phlegmonous cecitis may be divided into two types: the circumscribed phlegmon and the diffuse phlegmon. The circum-

scribed phlegmon of the cecum is characterized by an irregularly oval or circular area of edema and redness, sharply differentiated from the surrounding normal tissue. The area is frequently covered with thin, grayish-yellow fibrin and feels doughy. Occasionally, there is central softening in the mass due to abscess formation or to ulceration of the mucosa. The peritoneal cavity is relatively free of reactive fluid in this type.

The diffuse phlegmon is characterized by marked edema of the entire cecum, and in contradistinction to the localized form, its borders merge imperceptibly into the normal ascending colon. The edema is more pronounced and the involved area is an angry purple-red. The fibrinous exudate is thicker, shaggier and more grayish in appearance. In this type there are numerous punctate hemorrhages throughout the involved area. On palpation, the diffuse phlegmon is of a firm rubbery consistency. In most of these cases there is a reactive peritonitis as evidenced by turbid fluid and widespread deposition of fibrin.

The microscopic picture is essentially the same in both types. This consists of a profuse exudation of a collagen-rich fluid in the submucosa and to a lesser extent in the subserosa. There is an infiltration of numerous polymorphonuclear leucocytes in both these areas; in the circumscribed type this infiltration frequently terminates in focal abscesses which may coalesce in the submucosa to form larger abscesses. The muscularis and the mucosa are involved in the process but to a much lesser degree. Occasionally, an ulcer of the mucosa may form due to the presence of abscesses in the submucosa which break through into the lumen of the gut.

In sections stained for bacteria, they have almost invariably been found in the submucosa. In the diffuse phlegmon, the entire wall of the cecum may participate equally in the disease.

The microscopic process always extends for a considerable distance further than is evidenced by the gross appearance.

Bauer[16] has compared this type of inflammation and its spread to erysipelas.

The pathological process of phlegmonous cecitis has been frequently likened to that of appendicitis in the literature. Progression to gangrene and perforation is much more marked in appendicitis than in phlegmonous cecitis due to the scanty blood supply and the poor drainage of the appendix.

DIAGNOSIS

The difficulty of making a preoperative diagnosis in these cases has been stressed in the literature. Biedermann[17] states that even at operation in many cases the true nature of the condition cannot be ascertained. Fenkner,[18] however, believes that if this condition is kept in mind, the characteristic appearance of the lesion should permit the diagnosis to be made.

The symptomatology simulates that of acute appendicitis in most cases, being characterized by abdominal pain, fever and vomiting. There are cases of phlegmon of the cecum that closely simulate carcinoma because they present symptoms of obstruction and a mass. Other cases are difficult to differentiate from tuberculosis of the cecum.

The outstanding physical finding in phlegmon of the cecum is the presence of a mass in the cecal region. This mass is fixed or movable, depending upon the extent of the lesion, and is always tender, but the tenderness varies in degree. The above findings together with the history suggest appendiceal abscess.

From our study of the literature, it would appear that the very early appearance of a mass in the cecal region, e.g., within forty-eight hours, should aid in differentiating this condition from appendiceal abscess in some cases.

Those cases that simulate carcinoma or tuberculosis of the cecum can be differentiated only at exploratory laparotomy.

Occasionally, a case of regional enteritis may involve the cecum to such a degree

that it may simulate phlegmonous cecitis. Careful exploration will, in all cases, reveal involvement of the small intestine by the same process.

TABLE I

COLLECTED CASES OF PHLEGMONOUS CECITIS

Author	Cases	Age	Sex	Treatment	Result
Biedermann[17]	1	28	f	Ileocecal resection	Recovery
Bsteh[7]	2	22	m	Ileocecal resection	Recovery
		55	m	Exteriorization of cecum	Death
Bundshuh and Wolff[20]	1	31	f	Ileocecal resection	Recovery
Burke[19]	1	18	f	Appendectomy	Recovery
Cordes[8]	2	36	m	Resection of involved area	Recovery
		45	f	Ileocecal resection	Recovery
Fenkner[18]	7	?	?	6 appendectomies	Recovery
				1 excision	Recovery
Fenkner[18]	1	12	m	Ileocecal resection	Recovery
Häbler[21]	1	19	m	Partial cecal resection	Recovery
Jordan[22]	1	10	f	Excision of area	Recovery
Moll[23]	1	30	m	Ileocecal resection	Recovery
Møller[24]	2	32	f	Excision of area	Death
		26	m	Excision and appendectomy	Recovery
Nyström[25]	1	40	m	Excision and appendectomy	Recovery
Otto[26]	1	?	m	Appendectomy and secondary ileocecal resection	Recovery
Pich[13]	4	39	m	Appendectomy	Recovery
		26	m	Appendectomy and drainage	Recovery
		20	f	Appendectomy and drainage	Recovery
		30	f	Appendectomy and excision of inflammed area	Recovery
Reisinger[27]	2	?	m	Drainage	Recovery
		37	f	Drainage and partial resection of cecum	Death
Röpke[28]	1	16	m	Appendectomy	Recovery
Sarafoff[29]	1	49	m	Ileo-cecal resection	Recovery
Sonnenberg[29]	1	?	?	No information	Recovery
Szabó[10]	1	35	f	Ileocecal resection	Recovery
Teutschlaender and Valentin[31]	1	51	f	Ileocecal resection	Recovery
Thomas[32]	2	62	f	Appendectomy	Recovery
		?	?	Appendectomy	Recovery

Solitary ulcer of the cecum may produce a picture similar to that of phlegmonous cecitis, but is differentiated by the marked tendency to perforation in the former.

Very few hematological studies have been made in the reported cases in the literature, but in the early stages there is invariably a leucocytosis with a relative polynucleosis. In the more protracted cases there is a relative lymphocytosis.

TREATMENT

There is almost complete agreement as to the treatment of phlegmonous cecitis. It is believed that an exploratory laparotomy is indicated because of the difficulty in differentiating this condition from appendicitis. More than half of the cases in the literature have been subjected to an ileocecal resection. In some instances this was done because the lesion was not recognized at operation, and in others because the surgeon thought that the process would not subside with conservative therapy. In seventeen cases, appendectomy, with or without drainage, was done. All these patients recovered.

TABLE II

COLLECTED CASES OF PHLEGMONOUS COLITIS INVOLVING CECUM

Author	Extent of Lesion	Treatment	Result
Bohmansson[33]	Cecum and ascending colon	Appendectomy	Recovery
Ingier[6]	Cecum and ascending colon	No operation	Death
Köntzey and Jaki[11]	Cecum and ascending colon	Drainage	Death
Leuchtenberger[5]	Entire colon	No operation	Death
Moll[23]	Cecum and ascending colon	Ileocecal resection	Recovery
Orth[34]	Entire colon	No operation	Death
Pallin[35]	Cecum and ascending colon	Appendectomy and ileocecal resection	Recovery
von Saar[36]	Cecum and ascending colon	Ascending colon exteriorized; subsequent resection	Recovery
Sauer[9]	Cecum and ascending colon	Resection of cecum and ascending colon	Death
Szabó[10]	Cecum and ascending colon	Ileocecal resection	Recovery
Finsterer[1]	Cecum to middle of transverse colon	Resection of involved area	Recovery

If a correct diagnosis had been made, operation could have been avoided. Exteriorization of the involved area was the procedure used on one occasion. The methods of treatment utilized may be

seen by referring to the table summarizing the cases in the literature. (Table I.)

PROGNOSIS

The mortality of the cases reported in the literature, including our own, is 8 per cent. (Table I.) When the process is not limited to the cecum but extends to other parts of the large intestine, the prognosis is very grave, the mortality rate being 45.4 per cent. (Table II.)

REVIEW OF THE LITERATURE

A careful survey of the literature revealed that phlegmon of the cecum is a relatively uncommon disease. We were able to find thirty-five cases of phlegmon limited to the cecum and eleven cases of phlegmon of the colon in which the cecum participated in the pathological process. We excluded a case reported by Matthes in which there was a phlegmonous inflammation of the whole gastrointestinal tract from the esophagus to the rectum. For ease of presentation and visualization, the cases are summarized in two self explanatory tables. (Tables I and II.) It will be noted that Fenkner's cases are included in Table I although much essential data is missing. This was done because his description of phlegmon of the cecum was so characteristic that we believed he could be expected to determine with some degree of accuracy whether or not a particular case was one of phlegmonous cecitis.

ORIGINAL CASE REPORTS

We are presenting a summary of the hospital records of two cases of phlegmonous cecitis. These patients were admitted to Beth Israel Hospital on the service of Dr. P. Klingenstein.

B. P. No. 48811. June 7, 1932. The patient was a thirty-five year old white woman admitted to the hospital complaining of pain in the right lower quadrant. The onset of the present illness occurred suddenly ten days ago with griping, colicky pain limited to the right

lower quadrant. There was concomitant loss of appetite and "dyspepsia." Fever was not noticed, nor was there vomiting or diarrhea. No urinary symptoms were present. Repeated enemas afforded no relief. Her past history was irrelevant except for a laparotomy following accident to "internal organs."

Examination revealed a well nourished woman who appeared acutely ill. Apart from the abdominal examination, there were no abnormal physical findings. A lower median abdominal scar was present. There was moderate distention and a firm mass could be felt in the right lower quadrant. This mass was fixed, extremely tender and measured about three inches in diameter. There was considerable rigidity and rebound tenderness over the mass and surrounding it, and a positive psoas sign was elicited. The temperature was 100.6°F., pulse 84, and respirations 24. A white blood count was done and a leucocytosis of 19,200 with 83 per cent polymorphonuclear cells, of which 7 per cent were staff forms, was found. The urine was entirely normal.

The history, physical signs, and laboratory data were considered typical of appendicular abscess and laparotomy was accordingly undertaken. The abdomen was opened using the Battle-Kammerer incision. The cecum and appendix were visualized and the appendix, though slightly congested and thickened, revealed no evidence of any suppurative process. The mass felt before operation was represented by an area of thickening in the posterior cecal wall. This posterolateral cecal wall was edematous and indurated over an area whose diameter was about 2½ inches. The surrounding parietal peritoneum was also markedly edematous. The cecum was bluntly separated posteriorly but no evidence of any pus could be found. The ileocecal region appeared grossly normal nor were there any enlarged glands. The exact nature of the mass in the posterior cecal wall was obscure, the differential diagnosis being between a malignancy and an inflammatory process in the cecal wall. It was decided to await developments and to base further therapy on these. The appendix was removed and the abdomen closed without drainage.

The pathological report of the appendix was as follows: Grossly, the appendix was deeply hyperemic. Microscopically, the outer surface of the appendix was occupied by inflamed

tissue, partly forming an abscess wall. The muscular coats and mucosa were entirely normal. Diagnosis: Periappendicitis. From this report, it was obvious that the appendix was secondarily involved.

Convalescence was relatively uneventful except for a low grade fever up to 102°F. which persisted for the first ten days. Two white blood counts done on the sixth and twelfth postoperative days showed a progressive drop to normal levels. The mass remained palpable and slightly tender throughout the patient's hospital stay but it diminished in size and became progressively less tender. Twenty days after admission, a colon x-ray was done and the following report was obtained: There are changes in the lower and posterior wall of the cecum which suggest carcinoma of the lower part of the cecum. There is marked dilatation of the terminal ileum and cecum. Another x-ray done three days later was reported as follows: Further examination shows changes in the cecum which suggest beginning new growth, nondestructive in character.

Despite the x-ray findings, the general improvement of the patient and the subsidence of the mass influenced us in thinking that the mass was inflammatory rather than neoplastic in nature. The patient was thus discharged on July 2nd, twenty-five days after admission and advised to return in one month.

On July 29th, the patient was examined in the out-patient department and the examiner's note read as follows: The abdomen is soft. The mass in the right lower quadrant is no longer palpable. The inflammatory nature of the mass seems to be substantiated. The patient complains of occasional abdominal cramps. General condition is markedly improved and the patient has gained ten pounds. A final x-ray done on September 9, 1932, gave the following results: The cecum appears to fill out normally. Marked ileocecal incompetency still present.

H. G. No. 106877. November 24, 1938. The patient was a thirty-eight year old white man admitted to the hospital complaining of abdominal pain of six days' duration. At the onset his abdominal pain was generalized but after twenty-four hours it shifted to the right lower quadrant. Nausea and vomiting were absent but anorexia and mild constipation were present. The temperature taken on several occasions ranged between 99 and 101°F. The only pertinent fact in the past history was a

grippal infection about three weeks before the onset of his present illness.

The patient did not appear acutely ill. His temperature, pulse and respirations were normal and a white blood count revealed only a slight lymphocytosis with a total count of 5,600. On abdominal examination, there was a sharply localized area of tenderness over a narrow pencil-shaped mass in the right lower quadrant. This mass measured about 3½ inches in length and about ½ inch in width. In view of the paucity of findings, it was decided to observe the patient for further developments. On the second day after admission, the temperature rose to 100°F. and the mass became more tender. It was believed that we were dealing with an appendiceal abscess and the patient was therefore subjected to laparotomy.

The abdomen was explored through a Battle-Kammerer incision. On entering the peritoneal cavity, the omentum was found covering the cecum. When this was lifted, the cecum was seen to be reddened and edematous and there were numerous petechial hemorrhages over an area on the cecal wall, just lateral to the anterior tenia. This area measured about 1½ inches in length and ¾ inches in width. The appendix was visualized and though reddened, did not appear acutely inflamed. Palpation of the edematous area in the cecum, revealed the fact that the wall measured almost ½ inch in thickness and a vague central depression was palpable which, it was thought, might correspond to an ulcer. There were no enlarged glands in the ileocecal angle. A small portion of the indurated area in the cecal wall was excised for biopsy and the appendix was removed.

The postoperative course was uneventful, the wound healing by primary intention. The pathological report follows: Gross: Small, bloody strip of tissue, 0.9 cm. long, 0.2 cm. wide The center is occupied by a darker brownish round zone, 2 mm. in diameter. Slightly hyperemic appendix, 6.5 cm. long. Microscopic: Edematous, partly hemorrhagic inflamed connective tissue and fat tissue. Mononuclear elements prevail. The subserous layer of the appendix and adjacent portions of the outer muscle coat contain numbers of lymphocytes. In some blood vessels eosinophile leucocytes are numerous. Diagnosis: Inflamed tissue; periappendicitis.

Ten days following operation, an x-ray of the colon was taken and the following report was received: The colon is morphologically normal. The cecum is also morphologically normal but is characterized by marked increase in peristalsis. The presence of retroperistalsis suggests the possibility of a superficial ulcerative lesion, perhaps tuberculous in nature.

The patient was discharged on December 8th, fourteen days after admission, with no symptoms, but with the mass still palpable. He returned to the out-patient department on December 30th, still asymptomatic, but with the mass still palpable. On January 11, 1939, the patient was again seen in the out-patient department and at this time the mass could no longer be felt and the patient had gained five pounds in weight. An x-ray taken on January 17, 1939, showed only slight spasm in the cecocolic tract but no findings of any significance. On follow-up on July 12, 1939, the patient complained only of an occasional tight feeling in the abdomen. There was no tenderness and no masses could be felt.

REMARKS

Inflammatory disease of the appendix is the causative factor of most acute pains in the right lower quadrant of the abdomen. This fact has led many observers to deny the actual existence of the disease known as typhlitis (cecitis), a condition frequently diagnosed before acute appendicitis became known as a disease entity. As a matter of fact, Sprengel[7] in his book on "Appendicitis" states that if one excludes pelvic disease in the female, practically all cases of acute pain in the right lower quadrant are due to acute appendicitis. Cordes[8] in her article specifically contradicts this statement and points out that cases of typhlitis without any involvement of the appendix occur, both from her personal experience and from her survey of the literature. Our own cases and our study of the literature leads us to a similar conclusion.

The recognition of typhlitis or cecitis as a disease entity assumes importance in view of the delayed treatment of appendiceal abscess in the past few years. Lehman and Parker[25] in a recent article have described a delayed treatment of appendiceal abscess, and state that the majority of them disappear completely under such management. At elective operation some months later, they not infrequently find little or no abnormalities in the appendix. Ransom[?] also states that in some cases of appendiceal abscess, the mass may completely disappear and the appendix may be removed after some weeks or months as an elective operation. It is our opinion that some of these cases may never have been due to primary involvement of the appendix but represent instances of phlegmonous cecitis that have completely subsided. The two cases reported by us, if not subjected to laparotomy, would have been diagnosed as appendiceal abscess. The true nature of the disease was recognized only because they were operated at the time when the mass was present.

While casual inspection of our cases and those reported in the literature would lead to the belief that phlegmonous cecitis is an uncommon disease, we agree with Fenkner[18] that many of these are unrecognized because they are not subjected to laparotomy.

SUMMARY AND CONCLUSIONS

Phlegmonous cecitis is presented as a distinct disease entity.

The disease is uncommon but many cases are passed unrecognized.

Thirty-five cases have been collected from the literature to which we have added two of our own.

Differentiation between phlegmonous cecitis and appendiceal abscess can be made with certainty only at operation.

When the localized type of phlegmonous cecitis is found at operation, removal of the lesion is unjustifiable because spontaneous subsidence is the rule. In the diffuse phlegmon, the best results have followed ileocecal resection.

The mortality of phlegmonous cecitis in the thirty-seven cases was 8 per cent. The three deaths occurred in the diffuse type only.

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AN OPERATION FOR PILONIDAL SINUS

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A GREAT deal has been written within recent years on the subject of pilonidal sinus. According to in-

The procedure which is here submitted has been used for the last fourteen or fifteen years, and while results have not
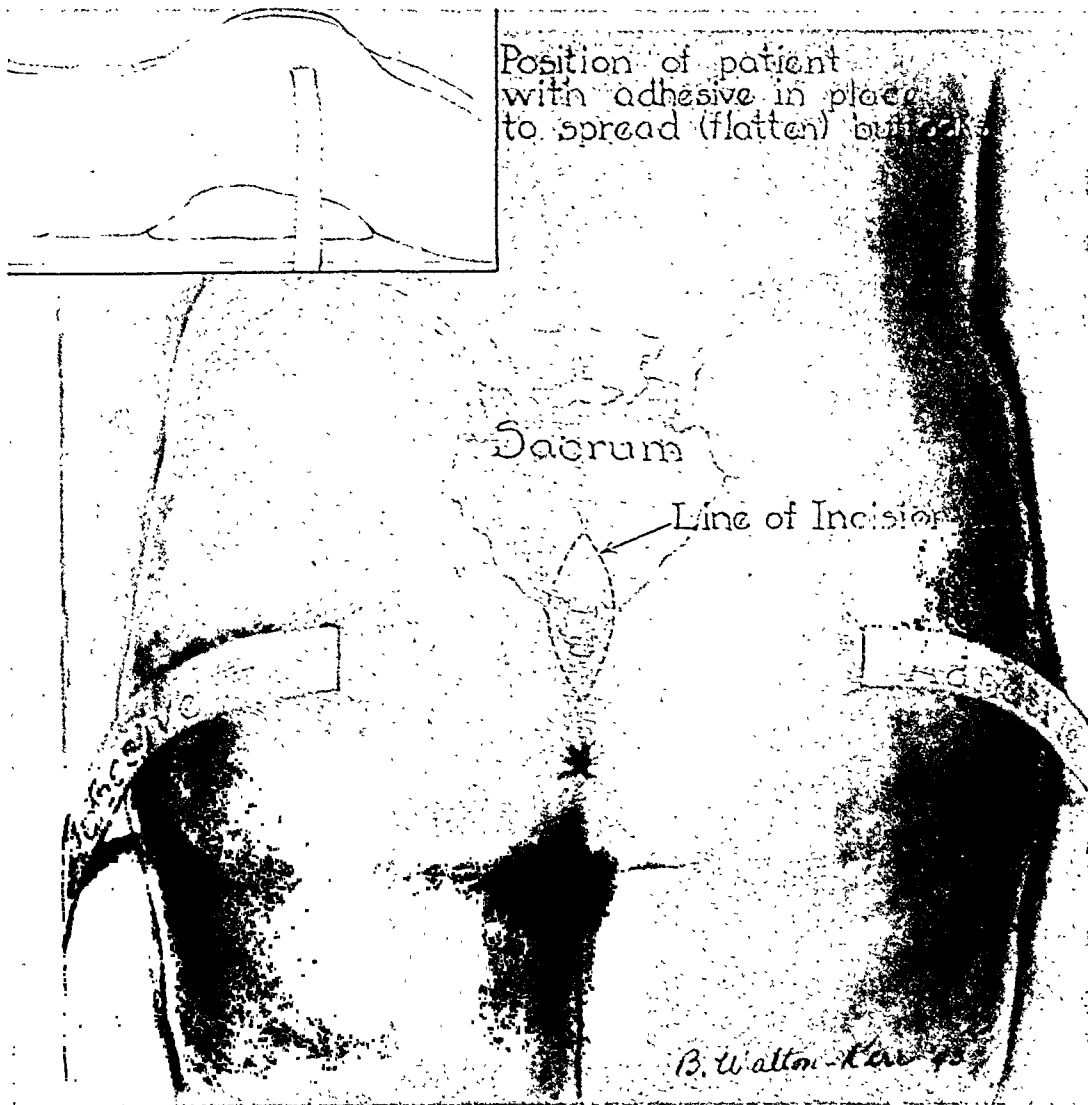

FIG. 1. Position on table.

formation pilonidal sinuses today are causing more disability and hospitalization in Army Camp Hospitals than almost any other single condition. Multiplicity of methods indicates dissatisfaction with results. Some factors must explain the lack of uniform results obtained by the great variety of procedures which are being used.

always been perfect, they have been sufficiently good from the standpoint of primary healing to warrant consideration of this procedure.

There are certain fundamental principles underlying the management of pilonidal sinuses which all operations for their cure should observe: (1) The sinus or cyst must

61

be completely excised. (2) Hemostasis must be accurately obtained. (3) All dead space must be obliterated. (4) Primary closure is

sinuses and cysts. There is no unanimity of opinion as to the exact embryologic origin. There are two outstanding theories based
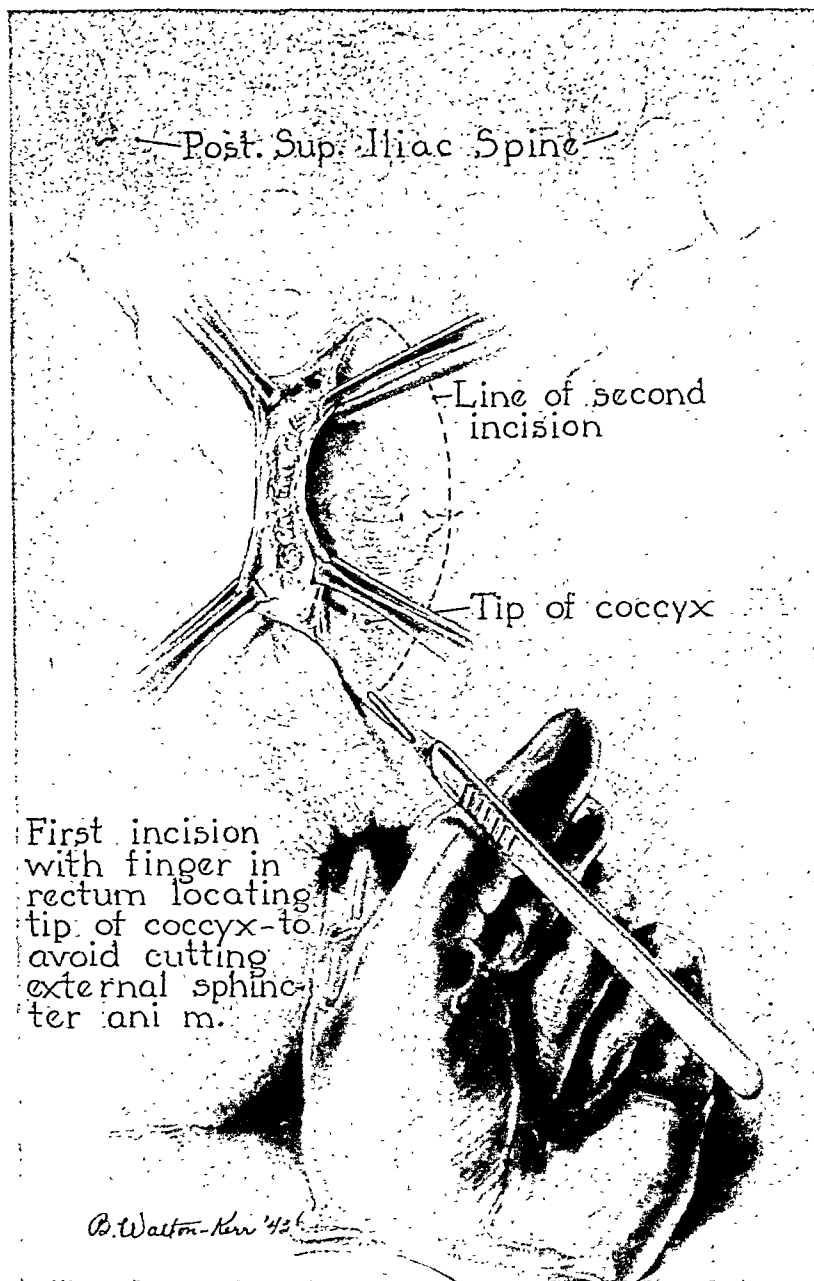
FIG. 2. Outline of proposed incision.

the method of choice. (5) In order to stimulate primary wound healing rest is essential. (6) There must be no tension on the suture line.

Etiology. Excellent studies have been made with reference to the origin of these

upon careful studies: Harvey Stone[1] and S. L. Fox,[2] along with many others champion the theory that these sinuses represent an ectodermal invagination. Gage[3,4] in a splendid study reaffirmed the theory advanced by Tourneaux and Hermann in

1887: "True pilonidal sinus has its origin from maldevelopment of the caudal end of the medullary canal and that maldevelop-

regulations require that candidates have this congenital anomaly corrected before he can be accepted for military duty.
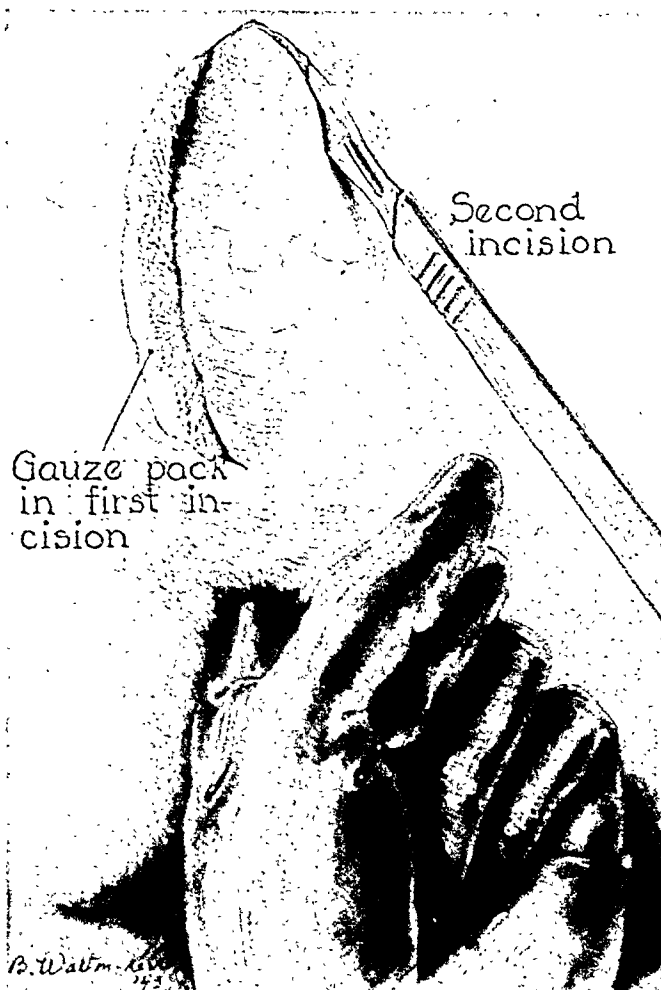

Fig. 3. Packing on one side while second part of incision is made.

ment of the caudal ligament results in the postnatal sacral dimple or sinus."

The frequency of the existence of pilonidal sinuses and cysts is not definitely known. Prior to war mobilization I venture the opinion that physical examination of many patients did not include investigation of whether a pilonidal sinus existed or not. Many patients had their attention directed to this condition only when an acute infection required drainage. It is needless to say that infection of the sinus would not have developed if the patient had been adequately examined and operation advised.

The importance and the frequent incidence of pilonidal sinuses has been particularly emphasized recently because army

Personal observations and contact with members of the Medical Corps of the Army has encouraged the publication of the procedure detailed in this paper.

During 1942 and the early part of 1943 excellent articles have been published by Kooistra,[5] William F. MacFee,[6] J. E. Dunphy and D. D. Matson,[7] Woldenberg and Sharpe,[8] Milton Camp and Nicholas Polites.[9]

Recent communications on the subject of pilonidal cysts and sinuses have stressed the importance of complete excision, hemostasis, and obliteration of dead space.

Statistics with reference to the cure and healing time vary a great deal. One recent author reports 98 per cent cures and com-

plete wound healing in 21.5 days, another author reports 74 per cent cures and a period of twenty-six to twenty-eight days

either by means of pillows or an attachment to the table.
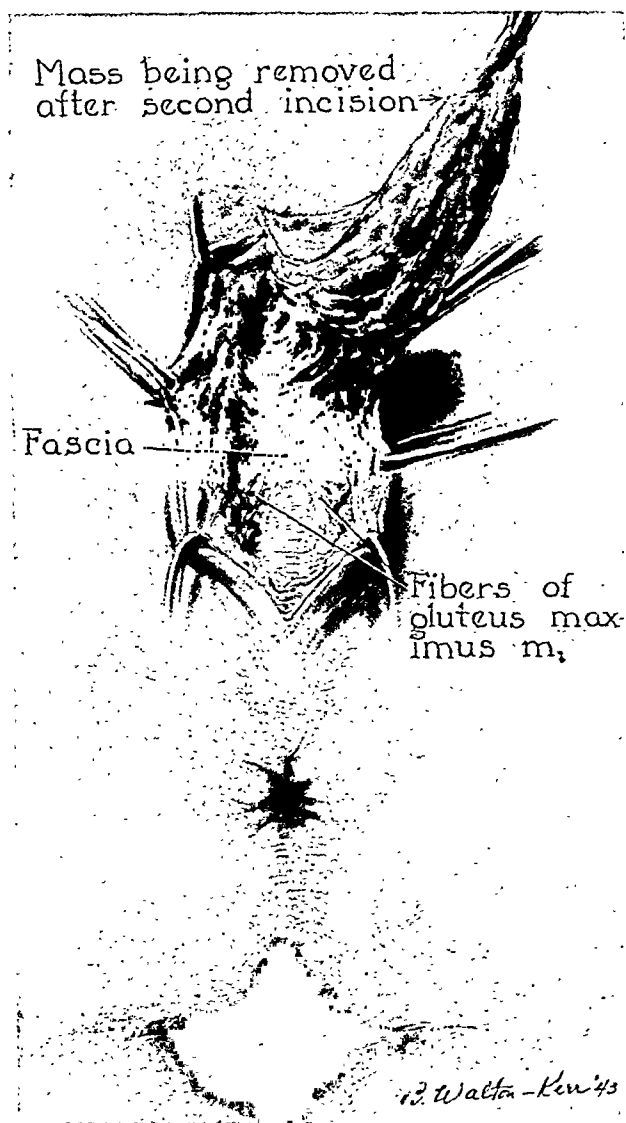
The buttocks are separated by making

FIG. 4. Excision of all tissue down to the white fascia.

required for healing. MacFee reports the average healing time following suture of skin edges to coccygeal fascia in sixty-nine days. No statistics will be offered with reference to the procedure which is here submitted.

Since 1930, the following operation for pilonidal cysts and sinuses has been performed:

Position on Table. The patient is in the prone position with the buttocks elevated,

use of adhesive tape on either side and held to the side of the table. After proper preparation of a wide area, and after the operative field has been properly draped, the index finger is introduced into the rectum and pressed up against the coccyx. This enables the operator to know at all times the location of the attachments of the sphincter to the coccyx. This procedure helps to orient the operator and enables him to carry his incision immediately down

to the white fascia with greater mental comfort than if such a landmark is not used. This procedure may be objectionable to be ligated, probably the coccygeal branches of the sciatic artery. There are, of necessity, many small unnamed bleeding

Sutures are placed after removal of adhesive allowing relaxation of buttocks

Interrupted Burdick-Blair-Davis sutures for skin closure

a.
Deep sutures in position to obliterate dead space

b.
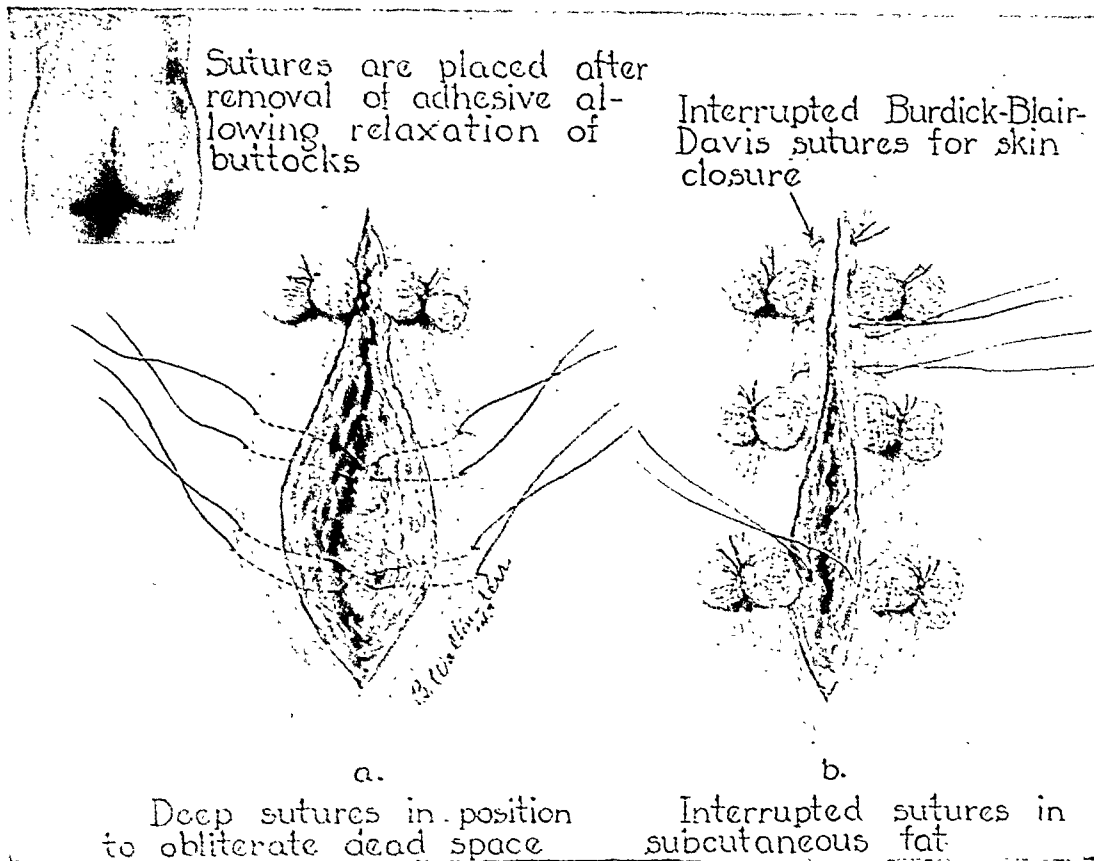Interrupted sutures in subcutaneous fat

FIG. 5. Indicates method of introducing longitudinal mattress sutures and wound closure.

to some on account of the possibility of contamination, but with adequate assistants the operator needs only his one hand, while his assistants maintain proper traction and retraction of the wound so that he can have adequate exposure. The primary incision extends through the fat well beyond the infiltrated area of the sinus or cyst, and in some instances the fascia covering the gluteal muscle is cut into. As soon as one-half of the ellipse is made, the wound is packed on that side and the ellipse is completed on the opposite side. In one mass the skin and sinus with fat down to the white fascia covering the sacrum and coccyx is removed. So far the steps are identical with every other procedure, the underlying principles of which are: adequate excision of all involved tissue, and complete hemostasis.

As a rule there are only two large vessels points. The use of a suction facilitates efforts to preserve a clean field.

The third step has to do with obliteration of dead space. A series of U sutures are introduced on either side about half an inch from the wound margin. These sutures are introduced first through the skin and are carried through the fat down to, and including the white fascia, a good bite of which is taken and then the needle is returned in the opposite direction back through the fat and out on the same side of the wound in which it was introduced. (Fig. 5A.) When these sutures have been introduced on either side of the wound, the subcutaneous fat is approximated with interrupted catgut sutures. The deep sutures are then tied over a small gauze roll. The skin edges are approximated with an everting type of suture, described by Burdick, Davis, and Blair independently.

No drainage is used in the majority of cases.

The wound is then dressed, care being taken that the adhesive dressing adequately brings the buttocks as closely as possible to one another, so that there will be no tension at any time on the wound margin. When the patient is returned to his bed, *he is kept in a prone position during the entire period of wound healing.* The common practice of allowing patients to assume the recumbent position, I believe to be one of the causes of some of the failures to obtain primary union. The recumbent position favors a separation of the buttocks and, therefore, an increase in tension on the wound; both conditions favor separation of wound edges.

Catgut has been the suture material used for all buried sutures and ligatures, and for the longitudinal mattress sutures dermal suture material has been used.

SUMMARY

1. An operation which has been in use for more than fourteen years by the author at the Touro Infirmary and Charity Hospital of New Orleans, is submitted for what it may be worth to others.

2. The fundamental principles are generally agreed upon: Complete excision, complete hemostasis, and obliteration of dead space without tension on wound edges.

3. The main point of variance with other procedures which have been submitted for this condition is the application of the mattress sutures at a distance from the wound edges, and not crossing in the midline, but coming out on the same side.

4. The after-care of the patient is particularly important. The main point which I believe should be stressed is the prone position. It is important that the patient not be allowed to be up and walking too soon. We generally preach rest and immobilization so that wounds will heal, and yet if the patient walks or sits down soon after an operation of this type, you cannot avoid increasing tension on the healing wound. I believe that this accounts for a good many delayed healing of these wounds which would otherwise unite by primary union.

The illustrations indicate the steps of the operation better than the word picture.

It is hoped that the procedure may be of service and be found worthy of use by others.

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TRAUMATIC RUPTURE OF THE SPLEEN*

EXPERIENCES WITH TEN CASES IN A GENERAL HOSPITAL

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DETROIT, MICHIGAN

RUPTURE of the spleen is said to be the most common of the serious subcutaneous abdominal injuries. Bronough (1935) reported that damage to the spleen occurs in 33.3 per cent of subcutaneous injuries involving abdominal viscera. Mazel (1932) reported a frequency of 30 per cent, while Wright and Prigot (1939) found the incidence to be 47.6 per cent, liver injury being next in frequency in the latter series with a 28.6 per cent incidence. These figures apply to peacetime, while in the present state of war, interest in traumatic injuries is increased with good reason.

Rupture of the spleen may be classified under the following six headings: Type 1. Spontaneous rupture of the normal spleen. Type 2. Spontaneous rupture of the diseased spleen. Type 3. Traumatic rupture of the normal spleen. Type 4. Delayed rupture of the normal spleen. Type 5. Delayed rupture of the diseased spleen. Type 6. Traumatic rupture of the diseased spleen. The first two of these types are not exactly apropos to the present discussion of traumatic rupture of the spleen, but for completeness will be included in the following discussion.

1. SPONTANEOUS RUPTURE OF THE NORMAL SPLEEN

This injury is exceedingly rare and, furthermore, many of the reported instances of its occurrence are open to the objection that an unrecognized previous abnormality of the organ may have existed. Susman (1927) suggested that the abnormality of the spleen may exist at one point only and that when the rupture occurs all evidence of pathologic change is destroyed. Grossman (1942) reported a case of spontaneous rupture of a normal spleen in an adult male. Even in this case there was evidence of a moderate degree of arteriosclerosis of the splenic arteries as well as suggestive evidence of a recent splenic infarction. Vanselow (1696) wrote a monograph in which he recognized the occurrence of spontaneous rupture of the normal spleen.

Zuckerman and Jacobi (1937) reviewed twenty-one cases of spontaneous rupture of the normal spleen, including one of their own. They ruled out trauma by lack of history and excluded previous abnormality of the organ by pathologic examination. Their own case had an abnormally mobile spleen and this may be a factor in some instances. The normal spleen is usually small and very well fixed in a protected position. Coleman (1939), like Grossman, found arteriosclerosis to be a factor in the causation of spontaneous splenic rupture in his single case. Ledderhose (1890), and Foucault (1925), and Smith (1934) all maintain that spontaneous rupture can occur only in a diseased spleen. For a review of this entire subject Susman's (1927), and Zuckerman and Jacobi's (1937) articles should be consulted. Up to 1937 they found twenty-one genuine cases and seven dubious ones in the literature. The condition was fairly evenly distributed throughout the various age periods and between the sexes. Pain in the left shoulder, although supposed to be a pathognomonic sign of splenic rupture, occurred only

three times. This does not entirely agree with the relatively frequent occurrence of this sign (Kehr's) in delayed splenic rupture as reported by Zabinski and Harkins (at least 28 per cent of sixty-eight cases). Roettig, Nusbaum and Curtis (1943) found Kehr's sign of little practical value. In five of Zuckerman and Jacobi's cases, the onset of the attacks occurred shortly after eating or drinking. Watson and Ferdeber (1942) reported a case in which intimal thickening of the intrasplenic vessels was present. These authors emphasize Hamilton Bailey's aphorism that: "In atraumatic hemoperitoneum in the male examine first the spleen." Roettig, Nusbaum and Curtis (1943) state that a more critical review of the literature casts some doubt on the probability of the existence of this syndrome, which they believe can be accounted for in most cases by being instances of delayed rupture with the history of previous trauma being overlooked. These authors conclude: "We are hesitant to conclude that spontaneous rupture of a normal spleen can occur."

In conclusion, it may be stated that spontaneous rupture of the normal spleen is an exceedingly rare occurrence if it happens at all. We had no such cases in our series.

2. SPONTANEOUS RUPTURE OF THE DISEASED SPLEEN

This accident is especially common in India where malarial spleens reach huge proportions. Maes and Rives (1941) state that one-thirtieth of all deaths in the malaria-infested area about Calcutta are due to such an accident. The exact definition between "spontaneous" and "traumatic" rupture of these large spleens is often very arbitrary. This type of accident may be hard to distinguish, therefore, from Type 6 (traumatic rupture of the diseased spleen). Torres and Lacorte (1941) reported a case of fatal splenic rupture occurring in the second week of typhoid fever in a male, aged twenty-one. Acute perisplenitis, intracapsular hemorrhages,

and distention of the capsule of a greatly enlarged spleen were present at necropsy. *Eberthella typhosa* were found in the blood and in pure cultures from the splenic tissue. The presence of two liters of blood in the abdomen accounted for the death of the patient.

In conclusion, it may be stated that in temperate climates where malaria is uncommon, this accident is very rare. We had no such cases in our series.

3. TRAUMATIC RUPTURE OF THE NORMAL SPLEEN

According to Berger (1902), about 51 per cent of individuals who experience acute rupture of the spleen die of hemorrhage within an hour of the accident. While this estimate may be somewhat exaggerated, the *seriousness* of this condition is thus at once apparent. The *frequency* of the syndrome has been emphasized by Wright and Prigot (1939) (one out of every 666 accident cases of all kinds admitted to the Harlem Hospital) and by Roettig, Nusbaum and Curtis (1943) (one out of every 920 accident cases admitted to the Ohio State University Hospital).

In the present war, traumatic rupture occurs following the usual types of accidents (falls, motorcycle injuries, etc.), but more especially from two other causes. These are, first, being jostled against the side of a tank when travelling rapidly over a rough road, and second, as the result of blast injuries. This latter cause was discussed by Gordon-Taylor (1942) in his review of war injuries occurring in England and it is noteworthy that the spleen is the most frequently damaged abdominal organ following blast injuries.

Roettig, Nusbaum, and Curtis (1943) have divided the pathological lesions in traumatic rupture of the spleen into five groups: Group I. Complete fragmentation of the spleen into two or more parts or complete separation from the pedicle. Group II. Large tear near hilus. Group III. One large or multiple small tears of periphery of spleen. Group IV. Solitary small

tear of periphery. Group v. Subcapsular hematoma. All of the first four groups are subject to immediate collapse while the last two (iv and v) are particularly responsible for the development of delayed rupture (vide infra).

Traumatic rupture of the normal spleen is statistically the most important of the splenic injuries. Occasionally, it may represent an open damage (gunshot or stab wound) but most often the wound is closed. This very fact renders the diagnosis somewhat difficult. The most important factor in the latter is the awareness of the possibility of such a lesion. Local pain in the left upper quadrant associated with a history of trauma, signs of blood in the abdomen (pain, ileus, distention, rigidity), and evidence that the blood loss is progressive and large (shock, blood pressure fall, tachycardia, pallor, anemia, faintness, sweating, etc.) are the chief diagnostic signs. Abdominal paracentesis as advised by Wright and Prigot (1939) and opposed by Maes and Rives (1941), may be misleading. The senior author (H. N. H.) had one case* in which no blood was visible with the patient supine even after making a short exploratory incision. (The same occurred in Case iv listed below.) On enlarging the wound it was found that there was considerable fluid blood in the peritoneal cavity.

The question as to whether splenic lacerations can heal spontaneously and remain healed is an important one in deciding on operation in any case of possible splenic trauma. Webb (1940) believed that recovery without operation is rare, quoting Turnbull of London as stating that he has never seen a scar of injury to the spleen, and J. S. McCartney and E. S. Bell, who, in 25,000 necropsy records at the University of Minnesota saw no instances of healed splenic hematoma. On the other hand Gunther (1939), McIndoe (1932), Zschau (1939), Goinard, Viollet, and Marchione, and Hunter (1935)

believed that splenic lacerations can heal spontaneously. This whole aspect of the subject is reviewed by Lommen (1942). Roettig, Nusbaum, and Curtis (1943) state concerning the healing of a splenic hematoma: "It is our conclusion that such a spontaneous cure rarely if ever occurs." Bailey (1927) evaded the issue nicely in this regard, stating: "The whole question of the natural repair of a splenic injury is an unimportant one. Nature fails so frequently that we must assume that surgical aid is always needed."

Untreated patients almost invariably die if the spleen is really ruptured. Berger reported 220 cases in which no operation was performed with a mortality of 92.3 per cent; Watkins, 100 per cent; Lewerenz, 85 per cent; and Connors, 100 per cent. Roettig, Nusbaum, and Curtis (1943) had seven untreated patients with six deaths (86 per cent mortality).

The possibility of splenic implants due to trauma which persist despite a splenectomy is to be borne in mind in the consideration of these cases. Hamrick and Bush (1942) found one such case in reviewing seventeen cases of traumatic rupture of the spleen seen at the Hillman Hospital, Birmingham, Alabama, during the six-year period 1933 to 1939. A boy, aged twelve, died following tetanus. Necropsy revealed several dozen microscopically identified spleens scattered throughout the abdomen measuring 0.5 to 1.0 cm. in diameter. Thirty-nine months previously (at the age of nine years) a splenectomy had been performed for a ruptured spleen six hours after a fall from a tree. These authors believed that the youth of the patient was an important factor in the survival of the splenic implants. This condition of splenosis is reviewed by Roettig, Nusbaum, and Curtis (1943) while Krueger and Mast (1942) have recently reported a case which, like that of Hamrick and Bush (vide supra), was also in a young (eleven year) boy.

Once the diagnosis is made, an immediate operation should be performed. In almost all cases, if the spleen is damaged, a

* Operation performed by the author in another hospital and hence not included in the present series.

splenectomy should be done. The first successful splenectomy for traumatic rupture was performed in 1892 (cited by Roettig, Nusbaum, and Curtis, 1943). These same authors concluded that: "The treatment of traumatic rupture of the spleen is always surgical and the operation of choice is splenectomy." The general trend toward an improvement in mortality can be gathered from Table 1, where it is

TABLE 1
RESULTS OF SURGERY IN SUBCUTANEOUS RUPTURE
OF THE SPLEEN
(From Rousselot and Illyne, with additions)

Author	Year	No. of Cases	Mortality Per Cent
Bessel-Hagen	1900	37	46
Michelsson	1913	298	33
Buxton	1922	...	29
McIndoe	1932	37	27
Foster	1940	20	30
Rousselot and Illyne	1941	17	29
Harkins and Zabinski	1943	10	30
Roettig, Nusbaum, and Curtis	1943	15	7

seen that an operative mortality of better than 30 per cent can be reached. The data in this table include all types of cases and operations. In our own series, the mortality would be less (22 instead of 30 per cent) if the rupture of the diseased spleen were not included. The table does not, however, include open wounds of the spleen which have a much higher operative mortality (63.6 to 66.6 per cent, Rousselot and Illyne, 1941).

CASE REPORTS

CASE I. M. S., a female store clerk, married, aged twenty-eight years, fell down a flight of stairs on October 1, 1929, striking the left side of her chest. Immediately afterwards she had sudden severe pain in the left upper quadrant and fainted. She was seen at the hospital forty-five minutes later at which time she was in severe shock with a blood pressure of 80/60 and with extreme pallor of the lips and nails. There was marked tenderness in the abdomen, especially in the left upper quadrant.

There was no shifting dulness in the flanks. After the administration of 200 cc. normal saline solution intravenously with 10 minims of adrenalin, the patient complained of a sharp pain in the left shoulder (Kehr's sign; possibly a renewal of the hemorrhage at this time caused a diaphragmatic irritation). The blood pressure was now 90/60, but soon sank to 62/48. A transfusion of 1,000 cc. citrated blood was then given with improvement in the general condition. A diagnosis of rupture of the spleen was made and four hours after the accident a splenectomy was performed through a left paramedian incision with a left transverse extension under ethylene and ether anesthesia. There was a large amount of fluid and clotted blood in the peritoneal cavity and a spleen weighing 220 Gm. with a horizontal tear almost completely across it was removed. After ligation of the pedicle, a large 4 inch gauze pack was inserted which was finally removed under ethylene anesthesia on the sixth postoperative day. A transfusion of 700 cc. of blood was given during the operation and another of 600 cc. afterward. Except for a slight bronchopneumonia of the left pulmonary base developing on the twelfth day the convalescence was uneventful and the patient recovered. There were no rib fractures. No red blood counts were done.

CASE II. E. S., a white newsboy, aged thirteen years, was struck by a car while delivering papers at 3:15 A.M. on February 17, 1935. He did not regain consciousness until admission to the hospital at 6:00 A.M. At that time the skin was cold and clammy, the fingers and ears cyanotic, the pulse 116, respirations 34, and the blood pressure 74/38. The abdomen was rigid and markedly tender in the left upper quadrant. There was an associated fracture of the nose and of the left ninth and eleventh ribs. Despite the administration of 200 cc. of 10 per cent glucose intravenously, the child's condition became worse and he became paler. A diagnosis of probable ruptured spleen was made and at 1:05 P.M., nine and one-half hours after the accident, a splenectomy was performed under ethylene-ether anesthesia through a left rectus incision. A large amount of blood was found in the peritoneal cavity and preliminary examination of the spleen by palpation showed it to be of normal configuration with no lacerations. After exploration of other organs, the spleen was actually

visualized and it was seen that the vessels of the splenic pedicle entering the organ were torn. The patient received four blood transfusions totalling 1,600 cc. the day of operation, two before, one during, and one after operation. The abdomen was closed without drainage, and after splenectomy, recovery was uneventful. No red counts were taken before operation.

CASE III. N. M., a white male laborer, aged fifty-seven years, fell off a ladder from a height of seven feet one hour before admission on April 7, 1941, at 11:00 A.M. The patient landed face downward and some object struck him in the epigastrium. It is not known whether he was unconscious. When first seen, his blood pressure was 70/40, the white blood count 10,000; the red blood count 5,500,000; the abdomen slightly distended and tender in the

TABLE II

SERIAL BLOOD COUNTS IN CASE III

Date	Hour	Hemo-globin Gm	Red Count Millions	White Count	Poly-morpho-nuclears Per Cent
4-27-41	11:00 A.M.	Time of accident			
4-27-41	12:00 M.	....	5.5	10,000	
4-27-41	3:00 P.M.	13.5	4.8	5,700	61
4-27-41	5:00 P.M.	13.4	4.8	22,000	
4-27-41	8:00 P.M.	....	...	32,000	92
4-27-41	11:00 P.M.	Time of operation			

left upper and right lower quadrants, and despite the high red count the patient appeared pale. He vomited and presented in addition a laceration of the lower lip. The patient was observed until 11:00 P.M., just twelve hours after the accident and eleven hours after admission. During this time his blood count showed the progressive changes shown in Table II. Roentgen examination revealed a large shadow of increased density in the left upper quadrant displacing the descending colon medially which is possibly a spleen. There were no fractured ribs. The blood pressure remained low although the patient improved somewhat temporarily, and was 84/62 at the start of the operation, despite the administration of 200 cc. of blood. Operation was performed at 11:00 P.M. under ethylene-ether anesthesia. The operative note gave the preoperative diagnosis as follows: "It was the writer's impression that a ruptured hollow viscus was present

because acute symptoms had appeared rather early for ruptured spleen." (The writers of the present article believe that this reasoning is fallacious and exactly the opposite from the usual occurrence. In addition, an operation for rupture of the spleen twelve hours after the accident is "late" rather than "early.") The abdomen was opened through a horizontal incision just above the umbilicus. On seeing a large amount of blood in the peritoneal cavity, a vertical midline extension was added to the transverse incision making a T-shaped wound. A lacerated spleen in two pieces weighing 438 Gm. was removed. Microscopic examination revealed marked hemorrhage to account for the increased weight of the organ. The patient received 1,200 cc. of whole blood and 600 cc. of plasma during the operation and 500 cc. of whole blood after the operation. Except for a mild bronchopneumonia of both lungs, convalescence was uneventful and the patient recovered.

CASE IV. C. J., a white male laborer, aged thirty years, fell fourteen feet into the hold of a ship on December 7, 1926, several hours before admission at 5:00 P.M. He struck himself in the left lumbar region and received fractures of the left seventh and eighth ribs. The patient was observed for a period of twenty and one-half hours in the hospital gradually becoming worse. His urine was bloody, the abdomen tender and distended. There was no shifting dulness. Operation was performed under ethylene-ether anesthesia through a left rectus incision with a "T" extension to the left. Considerable blood was encountered only after introducing the exploring hand. The spleen was found to be in two separate pieces which were removed, the pedicle ligated and the wound packed with gauze. The patient received one 500 cc. blood transfusion just after operation and another of similar size the next day. The removed spleen weighed 140 Gm. The patient died forty hours after operation. No red counts were done and no blood pressure readings are recorded. Necropsy showed a complete rupture of the left kidney with retroperitoneal hemorrhage, fracture of the seventh and eighth ribs, serosanguineous fluid (80 cc.) in left pleural cavity, and no intraperitoneal hemorrhage.

CASE V. E. G., a white male, aged eight years, fell four feet, landing on his abdomen, at 4:00 P.M. on April 2, 1931. The patient com-

plained of abdominal pain but had no nausea or vomiting or unconsciousness. On admission five hours after the accident, the temperature was 98.2°F., pulse 108, and respirations 24. The abdomen was diffusely tender and rigid. The white blood count was 25,000 with 95 per cent polymorphonuclear neutrophiles. The patient was treated for two days with a rising pulse rate and a temperature averaging 99° to 100°F. A chest roentgenogram was negative, however. The day after the accident the hemoglobin was 13.6 Gm. and the blood pressure 140/60. On April 4, 1931, at 11:30 A.M., i.e., forty-three and one-half hours after the accident, an exploratory operation was made with a preoperative diagnosis of intestinal obstruction, using ethylene-ether anesthesia and a right rectus incision. There was considerable blood in the peritoneal cavity associated with a tear across the middle of the spleen extending 2½ cm. into the substance. The upper end of the incision was extended to the left in an inverted "L," the spleen removed and the abdomen closed without drainage. The patient received 750 cc. of blood, 500 the day of operation and the rest the next day. Recovery was uneventful.

Comment. Few conclusions can be drawn from such a small series of cases, but several points may be emphasized which corroborate observations of other writers:

1. A rising or high white blood count may result from trauma or hemorrhage alone and is not necessarily a sign of infection. This point was reviewed by one of us (H. N. H., 1934) in other surgical conditions. Running a quarter of a mile may raise a normal person's white count to over 35,000 so it is not surprising if a splenic hemorrhage will do the same. Operation was delayed in Cases III and V, partly because of a high white count, for eleven and thirty-eight and one-half hours, respectively, after admission.

2. An increase in blood pressure, especially in young persons, may also be deceiving. One of us has observed that young persons with labile vasoconstrictive systems may overcompensate for hemorrhage in its early stages by an increase in arterial blood pressure. In fact, such a rise (occa-

sionally to 180 or more mm. of mercury) in a young person should serve as a warning rather than offer assurance of safety.

3. The following interesting point is illustrated by Case II in which at first no splenic bleeding was found at laparotomy: Even though palpation reveals no laceration of the convexity of the organ, this does not rule out the presence of a serious tear of the pedicle and its vessels which can only be found by exposing the part to direct vision.

4. Large amounts of blood were required in these cases, 2,300, 1,600, 2,500, 1,000, and 750 cc., respectively. The last listed patient receiving only 750 cc. was only eight years of age, whereas the patient in Case IV receiving only 1,000 cc. was the only

TABLE III
DELAY IN OPERATION IN FIVE CASES OF TRAUMATIC RUPTURE OF NORMAL SPLEEN

Case	Time from Accident to Admission—Hours	Delay from Admission to Operation—Hours
I	3¾	3¼
II	2½	7
III	1	11
IV	1+	19½
V	5	38½
Average....	2	16

fatal case in this group. It is quite probable that if operation had been performed more promptly, less blood would have been necessary.

5. All types of incisions were employed because of the various preoperative diagnoses. In all of our cases ethylene-ether anesthesia was used.

6. Most important, the delay in operation, as shown in Table III, is outstanding. An average interval of only two hours existed from the time of the accident until the hospital admission, in itself testimony to the acuteness of the condition. Once in the hospital, however, an average additional delay of sixteen hours occurred. In Case II a delay of seven hours could be

attributed to no single specific factor, but in Case III, as already cited, an altogether erroneous idea of the course of a patient with a ruptured spleen existed in the mind of the attending surgeon resulting in a delay of eleven additional hours. In Case V, a mistaken diagnosis of pneumonia caused a thirty-eight and one-half hour delay. One of the purposes of writing the present paper is to bring about a better understanding of this urgent acute abdominal condition and to make such delays as those listed above less frequent.

4. DELAYED RUPTURE OF THE NORMAL SPLEEN

This syndrome has recently been extensively reviewed by the authors. This sum-

TABLE IV

RATIO OF DELAYED TO TOTAL SPLENIC RUPTURES IN REPORTED SERIES

| Author | Year | Splenic Ruptures | | Delayed Ruptures as Per Cent of Total Cases |
		Delayed	Total	
Bailey (London Hospital)	1894–1926	6	32	19
Connors (Harlem Hospital)	1905–1927	3	32	9
Foster and Prey (Four Denver Hospitals)	1927–1938	1	20	5
Rousselot and Illyne (Presbyterian Hospital, N.Y.)	1941	1	17	6
Zabinski and Harkins (Henry Ford Hospital)	1926–1942	4	10	40
Roettig, Nusbaum, and Curtis (Ohio State University Hospital)	1943	2	8	25
Total		17	119	14

mary analyzed 177 cases collected from the literature including four of our own. The conclusions drawn from these cases and those reported in the literature are essentially as follows: "The total of 177 cases,

while it represents over two and one-half times as many instances of this syndrome as have been reported in any previous summary, still does not represent the true frequency of this condition. Traumatic rupture of the normal spleen is the most common serious subcutaneous abdominal injury. Delayed splenic rupture (the *hemorrhagie en deux temps* of the French, or *zweizeitige Milzruptur* of the Germans) represents about 14 per cent (one in seven) (Table IV) of all splenic ruptures. This syndrome is especially insidious and treacherous due to the almost symptom-free latent period, but the delay offers an opportunity for diagnosis and treatment.

"Delayed splenic rupture is most common in males in the second decade of life. Falls and traffic accidents are the most common etiologic agents. About 50 per cent of the secondary ruptures occur after an interval of less than seven days while in an additional 25 per cent the latent period ends during the second week. Fractured ribs on the left side occur in about 10 per cent of the cases while Kehr's sign (pain in the left shoulder due to phrenic nerve irritation) is present in about 28 per cent or more of cases. Other diagnostic aids include those used in diagnosing any type of splenic rupture, such as sudden collapse or shock, rapid or increasing pulse rate, progressive anemia, white count from 12,000 to 20,000, absence of fever over 99°F., pain, tenderness, dulness and rigidity in the left upper quadrant, and in some instances signs of free fluid in the peritoneal cavity.

"Without operation, the mortality ranges from 77 to 100 per cent. At the time of McIndoe's review (1932) the operative mortality was 27 per cent. During the past decade it has been only 10 per cent. When splenic laceration is suspected, the patient should be kept in bed under close observation. In more definite cases, or at the first sign of secondary hemorrhage, splenectomy should be performed. Adequate treatment of shock with plasma or whole blood forms a necessary adjunct to the operative procedure."

In general, the pathologic lesion found at operation in these delayed cases conformed to those of Groups IV or V of Roettig, Nusbaum and Curtis. Referring to these authors' classification (vide supra) of the pathology of splenic rupture, if delayed rupture occurs in Group IV cases (solitary small tear of periphery), it usually is because of temporary clot or omental tamponade which finally breaks down. In Group V cases (subcapsular hematoma) the eventual rupture occurs either because the pressure behind becomes so great or because the dome of the hematoma breaks down and necroses.

5. DELAYED RUPTURE OF THE DISEASED SPLEEN

By the very laws of chance, this syndrome is extremely rare. Zschau (1939) reported a delayed rupture of a leukemic spleen. We had no such cases in our series.

6. TRAUMATIC RUPTURE OF THE DISEASED SPLEEN

As previously mentioned in the discussion of Type II ruptures (spontaneous rupture of the diseased spleen), the distinction between the spontaneous and traumatic cases is often arbitrary as in instances of large and friable, or merely friable spleens, a little trauma may cause rupture of a very big organ. In our series we had one such example with a fatal issue, a brief report being appended:

W. K., a male laborer, aged fifty-seven, was injured on August 31, 1937 at 4:00 P.M. and a splenectomy was performed the next day. The man was an old patient of the hospital for polycythemic vera. Thus, on August 27, 1931, when first seen, his hemoglobin was 132 per cent, and the red blood count 9,640,000. The spleen was palpable two to three finger breadths below the costal margin, there was 2+ albumin in the urine, and the blood pressure was 154/108. The patient was treated with phenylhydrazine for seven weeks, the final red cell count being 7,200,000, and was then lost track of until the day of the accident. He was injured at 4:00 P.M. on August 31, 1937. A laceration of the scalp was sutured and in the night he

was brought to the hospital at 6:00 A.M., September 1, 1937. Further details of the injury are not available. On admission, fourteen hours after the accident, a roentgenogram of the chest demonstrated a fracture of the left eleventh rib in the posterior axillary line and consolidation of both lung bases. The patient was in profound shock (blood pressure 90/40). The pulse was 110, respirations 26, and temperature 102°F. The patient was pale, semicomatose, rousing at times and complaining of intense pain in the abdomen associated with marked tenderness but little rigidity. Splenectomy was performed at 1:00 P.M., seven hours after admission. Considerable blood was found in the peritoneal cavity and the spleen contained several deep lacerations. Two blood transfusions were given before operation, another of 750 cc. during and a fourth of 500 cc. after operation. Despite the blood, intravenous glucose, and oxygen therapy, the patient died at noon, September 2, twenty-three hours after operation and forty-five hours after the accident. Death was attributed to pulmonary edema and shock. No necropsy was obtained. The temperature two hours before death was 105°F., pulse 120, and respirations 30.

The removed spleen weighed 1,000 Gm. and measured 22 by 13 by 7 cm. The capsule was greatly thickened and along one edge there was a hyalinized plaque 12 by 3 by 0.3 cm. On the upper posterior surface there were two areas of superficial rupture measuring 5.5 by 1.0 cm. and 6.0 by 0.8 cm. There was interstitial hemorrhage and a subcapsular hematoma.

Comment. Earlier operation and recognition of the tendency of an enlarged spleen to rupture would have given this patient a better chance. A delay of fourteen hours occurred before admission to the hospital and another of seven hours in the hospital before operation was performed.

SUMMARY AND CONCLUSIONS

1. A classification of splenic rupture into six types is made.

2. From the practical standpoint, Types 3 and 4 are by all odds the most important. Of our ten cases, five are classified as Type 3, four as Type 4, and one as Type 6.

3. For traumatic rupture of the spleen, immediate splenectomy is the ideal mode of treatment.

4. For delayed traumatic rupture of the spleen, a similar therapy is essential, but almost as important is the realization that such a syndrome does occur. Traumatic rupture of the spleen of all types is the most frequent serious subcutaneous abdominal injury. At least one-seventh of all splenic ruptures are of the delayed type.

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DIAGNOSIS OF PERFORATED ULCER*

TWO USEFUL MANEUVERS BY MEANS OF WHICH PNEUMOPERITONEUM AND DIAPHRAGMATIC IRRITATION ARE DEMONSTRATED MORE CLEARLY

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PERFORATED peptic ulcer usually presents a classic abdominal picture. Severe abdominal pain, commonly in the epigastrium, early prostration, marked tenderness and board-like rigidity, low temperature, and slow pulse feature the event. Its differentiation from other abdominal catastrophes such as acute pancreatitis and mesenteric thrombosis is difficult at times.

Spontaneous pneumoperitoneum is pathognomonic. Weinberger[1] first noted radiologically "subphrenic pyopneumothorax" in 1908. Popper,[2] in 1911, observed air beneath the diaphragm and reported this in 1915. Wieland[3] also noted this in 1915. In 1925, Vaughan and Brams[4] demonstrated gas radiographically in the peritoneal cavity in thirteen (86.7 per cent) out of fifteen proved cases of peptic ulcer perforation. In 1929, Vaughan and Singer[5] reported positive evidence of pneumoperitoneum fluoroscopically in fifty-four (85.7 per cent) of sixty-three cases. In the series of Odom and Debakey[6] 106 (64.6 per cent) of 164 cases showed subphrenic air. Other investigators have found positive evidence roentgenologically in 67.7 per cent,[7] 70 per cent,[8] 83.3 per cent,[9] 98 per cent,[10] and 100 per cent[11] of cases. Debakey,[12] in a review of the literature, collected a series of 1,267 cases in which 879 (69.4 per cent) presented pneumoperitoneum by x-ray. It is our opinion that, on the average and in average hands, pneumoperitoneum is not observed radiologically, be it by film or fluoroscope, in more than 50 per cent of instances.

Cope[13] states that phrenic shoulder pain is present in more than 75 per cent of cases of perforated ulcer at some time in their clinical course. He notes that inquiry should be made concerning this pain since the abdominal pain usually overshadows that felt in the shoulder to such an extent that no spontaneous complaint may be made. According to Cope, the perforation of a duodenal or pyloric ulcer usually causes pain in the right supraspinous fossa or over the acromion process and less frequently over the deltoid and clavicular regions, anterior gastric perforations may produce referred pain in the left clavicular and acromial regions, and perforations near the cardia are apt to cause pain in both shoulders. In about one case in four, pain is felt in both shoulder regions. Oehlecker[14] specifically asked a group of patients about shoulder pain and found it present in 90 per cent of cases. His successors, Rodelius and Bruth, found it present in more than 80 per cent of their cases. Oehlecker reasoned that the falciform ligament directs the flow of fluid to either the right or left subphrenic spaces and that a large quantity would reach both sides. We have demonstrated this in the cadaver. The incidence of referred phrenic pain varies in different series from above to none in sixty-two cases.[15] In the low incidence groups, no notes as to specific interrogation are made.
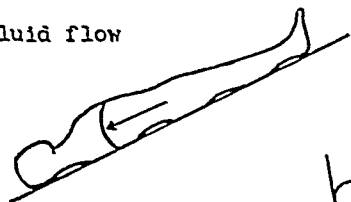
Of Debakey's[12] 1,657 collected cases, shoulder pain was found in 375 (22.6 per cent). Clinically, obliterated hepatic dulness is

wise, specific interrogation should be made by the examiner. Cutaneous hypersensitivity in the shoulder regions should be noted.
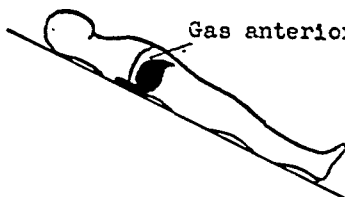
Position 1.

Fluid flow

Position 2.

Gas anterior to liver

Radiologic Position

Gas superior to liver

A.E.P.

Fig. 1.

a variable sign. Kellogg[16] states it is infrequent and was absent in 100 cases observed by him. Its incidence in the literature varies from this to 100 per cent as noted by Soupault[17] and Chabrut[18] (twenty-five cases). Field[19] noted changes in hepatic dulness which were more marked when the patient was allowed to lie on his left side. Bower[20] demonstrated the value of turning the patient from the prone to supine position to note this sign.

These maneuvers by means of which pneumoperitoneum and diaphragmatic irritation may be demonstrated more clearly, are best performed on the tilt radiographic table. The attending surgeon or resident should accompany the patient to the x-ray laboratory at the time when the scout film is taken. Positive findings, by this method, depend on the presence of either gas or fluid or both, whereas radiography is usually positive in the presence of gas only. The patient is placed supine on the table in the usual manner. First, Trendelenburg position of at least twenty-five degrees is instituted (position 1). When there is free fluid which flows toward the diaphragm, the patient may complain of referred phrenic nerve pain, spontaneously. Other-

Clinically, one may demonstrate, as Oehlecker[14] and Cope[13] have shown, "that irritation of the anterior portion of the diaphragm causes pain in the corresponding clavicular or supraclavicular regions; irritation of the posterior diaphragm causes pain in the supraspinous fossa of the same side; irritation of the top of the phrenic dome causes pain in the corresponding acromic-clavicular regions; and, finally, pain felt over both shoulders indicates a median diaphragmatic irritation."[13] At this time, hepatic dulness is also noted by percussion. After several minutes, the table's tilt is reversed and the head is elevated about twenty-five degrees (position 2). A small sandbag is placed beneath the right scapular angle. In this position, the gas lies anterior to the liver. One is able to note more easily obliteration of hepatic dulness because the space anterior to the right lobe of the liver presents the highest portion of the peritoneal cavity, and the gas collects there. For radiography, the head is elevated further so that the highest peritoneal pocket lies above the liver (radiologic position).

We have recently seen a case with abdominal pain of sudden onset, no rigid-

ity, and otherwise negative except for left suprapinous fossa pain. Laparotomy revealed a posterior gastric ulcer perforation. We have also been able to percuss obliterated hepatic dulness recently in six cases in which pneumoperitoneum was not detected by roentgenogram simply because the technician failed to have the patient sufficiently upright. It is, therefore, important to observe that in the clinical demonstration of pneumoperitoneum the elevation of the head should be twenty-five degrees whereas in its roentgenologic demonstration the elevation of the head should be as close to ninety degrees as possible.

It may be advantageous to operate with the patient in the head elevated position inasmuch as the perforation usually can be more easily approached. Further, concentration of suction in the pelvis permits a more complete removal of the free fluid which has gravitated there. A definite effort should be made to get as much of the gastrointestinal contents as possible out of the peritoneal cavity at the conclusion of the operation.

SUMMARY

The value of shoulder pain and its exact localization as well as the obliteration of hepatic dulness in the diagnosis of perforated peptic ulcer is discussed. The need for specific interrogation concerning the former is stressed. The use of Trendelenburg and reverse Trendelenburg positions in the demonstration of these two signs is presented.

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THEORY AND THERAPY OF SHOCK*

EXCESSIVE FLUID ADMINISTRATION

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EXPERIMENTS in the preceding paper showed that by refrigeration of the tissues from which shock originated, dogs gained a respite of time and strength to profit by administration of fluids in the stomach or under the skin. This carried an obvious suggestion to give the fluid intravenously, to equalize the absorption with nonrefrigerated dogs and also to increase the quantities. This was also logical because of the existing status of clinical treatment. Oxygen therapy has failed to overcome the anoxia. Changes of bodily position are worthless in shocked animals; and while there may be some benefit for cardiac or vasomotor collapse in patients, authorities have pointed out that the traditional head-down position is irrational for the capillary stasis of shock and probably lacks even emergency value. Adrenal extract is either discredited or at least not demonstrated to the satisfaction of many competent judges. The one universally accepted effective treatment of shock is the intravenous injection of fluids, especially blood plasma or its substitutes. Nobody claims that the severest shock is curable by any method. Also, severity is not governed merely by the original cause, but excessively long continuance of shock creates the most dangerous state. The irreversibility of very advanced shock is undisputed. Any therapeutic advance requires an attack on this problem of irreversibility. The existing information on it must, therefore, be examined. The survey can be brief and general, because of the detailed references supplied in the excellent reviews of Blalock and especially Harkins and Moon.

In beginning, the remarks concerning anesthesia in the preceding paper need to be amplified. The sensitization to histamine produced by anesthetics has been noted by the Mylon-Winternitz group and earlier writers. The barbiturates in particular can cause low blood pressure, anoxia, reduced volume flow and increased concentration of the blood. These effects deceptively imitate and may to some extent be identical with shock, but there is also a fatal action of entirely different character. Moon has emphasized this complication and has used it to attack a considerable part of Blalock's experiments. He also quotes Mann and others to the effect that many investigators have been studying deep narcosis instead of shock. Recently Muirhead, Ashworth and Hill have correctly described the effect of nembutal, which may be responsible for apparent failures of plasma treatment in shock.

Anybody can easily confirm this result as follows: The proper intraperitoneal dose of nembutal in shock is about one-third to one-eighth of the normal average, depending upon the degree of shock. This fractional dose produces in the shocked animal the same degree of unconsciousness which is produced by a full dose in a normal animal, namely surgical anesthesia with retention of the conjunctival reflex. These minimal doses suffice for all needs and are permissible because they do not spoil any experiments; in particular, dogs receiving any effective treatment for the shock wake up quickly. A full normal dose in the shocked animal is fatal, as can be proved by tests in prolonged shock, and by the failure of every kind of treatment to save

life. Remarks of authors such as Mahoney, that "the pulse, blood pressure and respirations remained well within normal limits when no shocking procedure was carried out," are meaningless. The essential fact is that when shock is induced rapidly, so that it reaches a severe stage during the maximum effectiveness of the anesthetic, the narcosis deepens as the shock deepens and the combination is hopeless.

The reason for insistence on this small technical point is that it means nothing less than the discarding of a large part of the literature of shock. For example, Wiggers stresses the irreversibility of shock, and also properly insists on technical precision and the training of his students in anesthesia. But this is the very point in which his large data collide with a small fact. The customary method was described by Wiggers and Werle: "As in previous experiments, dogs under morphine sodium barbital anesthesia were bled until a period of marked hypotension was maintained for 30 minutes to 2 hours. At the end of such a period, the withdrawn blood was reinfused and the course of dynamic events followed for 4 to 5 hours, unless death occurred earlier." This appears to be a formula for narcotic poisoning. Unless the small fatal error of anesthesia can be disproved, the entire work of Wiggers on shock must be rejected. Shock is according to generally accepted definition a capillary process, and Wiggers' introduction of a primary cardiac or possibly vasomotor factor in the fatal outcome is not admissible unless it is demonstrated in pure shock. The point of main interest in the present connection is that Wiggers has no evidence of the irreversibility of shock.

Simple saline solutions were the first to be used with therapeutic effect, beginning with the famous O'Shaughnessy-Latta cholera treatment in 1831. Pilcher and Sollman, in 1914, showed that after prolonged hypotension from hemorrhage, the blood pressure of dogs could not be restored or their lives saved by restoration of the blood volume with salt solution or the original blood. Smith and Mendel, in 1920, proved that saline injected in rabbits in amounts equal to the calculated blood volume mostly passed out of the circulation during the injection or within five minutes afterward. Lumière, in 1924, recommended large saline infusions for anaphylactic shock, but preferred an addition of 3 per cent gum arabic. Underhill gained credit for his introduction in 1927 of large volumes of salt solution in the treatment of burns. MacFee and Baldridge, in 1934, emphasized the dehydration factor in shock and the value of large saline infusions, their extreme example being a patient who received 4,000 cc. in two hours. Recently, however, Rhoads et al. reported a case of burn in which 5,000 cc. of saline was given in nine hours and the hematocrit reading nevertheless rose to 77 per cent. Also in 1934 Atchley and Loeb, after a historical review of the O'Shaughnessy cholera treatment and the obstruction of progress by the medical centers of that time, listed various states of dehydration and shock treated with saline infusions, the highest dosage being 7,200 cc. in a case of rattlesnake bite, and concluded that the ideal treatment of shock is by transfusion; "when salt solution has failed, transfusion may turn the tide." The preferred position given to saline solution by Hoitink was due only to primitive transfusion methods and the disadvantages of gum arabic. The experiments of Hepler and Simonds accorded with present-day views by showing that saline infusions equal to the calculated blood volume kept the blood pressure of (etherized) shocked dogs elevated for only one to three minutes after the stopping of the injections, and that harm was done by increasing tissue edema and loss of protein from the blood. Most recently, Abbott and Mellors have emphasized the impoverishment of plasma proteins in dehydrated malnourished patients, rendering them susceptible to edema with the consequence that infusions of 2,500 to 7,000 of physiological saline create danger of pulmonary edema, atelectasis and bronchopneumonia.

The saline injections in the literature of shock have usually ranged from small amounts up to the estimated blood volume as a maximum. Davis's experiments were exceptional, in that he studied the metabolism after shock was produced by hemorrhage, limb trauma, portal vein ligation or histamine injections in dogs of 10 to 20 kg. weight, which then received 0.9 per cent sodium chloride solution into the femoral vein at the rate of 16 cc. per minute until 3,000 cc. had been given. This admirably comprehensive plan showed an abnormal metabolic response to fluid in shock. In normal dogs, a maximum increase of metabolic rate by 25 to 50 per cent was reached after injections of 1,400 to 2,400 cc. and then remained at a plateau. Fluid to the extent of 25 per cent of the body weight could be injected without deleterious result. In traumatic shock, the maximum metabolic increase was reached after infusion of 700 to 1,200 cc., and there was a progressive decline with further injection. The tolerance for fluids was diminished; the anoxemia of shock was intensified, through impairment of both transportation and utilization of oxygen, with quantities of fluid which would not affect a normal animal. The result of the experiments in general was that the saline infusions caused increased leakage of plasma proteins and hastened death. The dogs were under sodium barbital anesthesia, and the description of anoxemia, urinary suppression and early death corresponds to my own experience with narcotic poisoning in shock.

The failure or harm of saline and the superiority of plasma, serum or substitutes for maintaining blood volume and composition are affirmed without exception by investigators of all possible states of hemorrhage and shock, experimentally and clinically. Besides the older citations given by the reviewers, a partial list of the recent supporters of this view comprises the J. G. Allen-Dragstedt group, Buttle et al., Dunphy and Gibson, Freeman, Gutman et al., Harkins and McClure, Helfrich et al., Konrich, Mahoney et al., Muirhead et al., Weil and Meakins, and White et al. The general tendency is to emphasize the large quantities of fluid and plasm protein lost in shock, and to report better results with larger and larger infusions of plain, diluted or concentrated plasma or serum or substitutes. Nobody denies that a certain degree or stage of shock is irreversible and irremediable by any of these measures. Blalock took pains to prove that blood transfusions fail to save unanesthetized dogs in the late stage of hemorrhagic shock, and the experimental and clinical observations with plasma lead to the same conclusion for advanced shock of every origin.

My experiments published in 1939 agreed with Blalock and others in showing that blood transfusions in severely shocked rats resulted in overstuffing the blood vessels with blood of progressively increasing corpuscle content, and that life was prolonged but not saved. In other experiments, successive injections of plasma were given in such a manner that the corpuscle counts were kept approximately normal or actually reduced from beginning to end. Hemoconcentration in the ordinary sense was thus prevented, and the blood volume was evidently not diminished because in the later stages the vessels were visibly distended and plethoric. Life was preserved longer than with whole blood, but was not saved. These experiments still appear to be the most decisive on record with regard to the limitations of plasma treatment. They might be interpreted in favor of the toxic theory of shock. On the other hand, the fact that blood or plasma from rats dead in shock was practically as beneficial as normal blood or plasma for the temporary revival of shocked rats showed at least that no high concentration of toxin could be circulating. Saline infusions succeeded in severe shock where the plasma failed. But (owing perhaps to deficient constitutional strength of rats or to the unavoidable anesthesia) the severest degrees of shock proved fatal in spite of any treatment.

Although Moon furnished the best phrasing of the idea that "the wheal is shock in miniature," he did not draw the therapeutic inference which seemed to me logical. Is it rational to try to prevent formation of the wheal? Since shock is by definition a fluid shift, and the injured tissues evidently somehow need fluid to form the "wheal," why not help them to form it by supplying a fluid that will pass readily through the capillary walls? As mentioned in the preceding paper, the conceptions of physicochemical equilibrium, capillary permeability and tissue need or avidity are doubtless more or less synonymous, and abnormal permeability can presumably be compensated by a change in fluid composition. But the different phrases create different superficial impressions, since we can expect a tissue need for fluid to become satisfied after sufficient fluid is provided, but the believers in abnormal permeability have inferred that the capillaries would continue to pour out water, salts and protein until the organism was drowned. Accordingly, ever since the first introduction of the colloid concept and gum arabic, physicians and experimenters have unanimously concentrated on treating the blood instead of the patient. The real task is to cure shock which cannot be cured by blood or plasma. If this can be accomplished, the correction of any deficiency of the blood in cells or protein is a secondary problem. According to this concept, when a therapist makes the stereotyped complaint. "I have given large saline infusions and they do not prevent hemoconcentration and only carry protein with them out of the vessels," the proper answer is, "Excellent. Now continue to give more saline until the tissue demands are satisfied so that fluid remains in the vessels and hemoconcentration is abolished." The precise question to be answered experimentally therefore is: Can salt solution establish a lasting equilibrium between the intravascular fluid and the extravascular fluid of the "wheal," or will plasma depletion and edema formation continue to an unlimited and fatal degree? The main point in my rat experiments was that within wide degrees of shock the former result is attainable.

EXPERIMENTS WITH EXCESSIVE FLUIDS

In the first type of experiments to be illustrated, dogs in the extreme stages of fatal shock produced by leg ligation were given either continuous physiological saline infusions by cannula or else repeated large injections (with a 50 or 100 cc. Luer syringe and an 18 gauge needle), the latter being usually preferred. One jugular vein had previously been exposed under the light anesthesia previously described, and by the time the injections were begun the weakness and apathy had reached a point which precluded any struggle. In this first type, the total volume of injections was intentionally excessive, to ascertain the disposal of the fluid and its effects.

Dog 267 (Table 1) was shocked by six and one-half-hour ligation of both hind legs, and three and three-quarter hours later was near death, with reduced rectal temperature and high red cell count. The blood was extremely dark, as seen in the poorly filled jugular vein and the scanty sample obtained from the ear. The dog might have died within a few minutes and certainly could not have lived an hour. A quick emergency injection of 200 cc. saline was considered necessary, and was followed with a slower continuous drip. Weakness, or pulmonary rattles heard with or without a stethoscope, were a signal for slower infusion. Within twelve hours the dog thus received saline intravenously to the extent of about two-thirds of his body weight, and the net result of injection, water drinking and profuse diuresis was a gain of about one-third of the original body weight. There was a general swelling of the body, such as Cutting and associates have described, trivial amounts of fluid in the serous cavities, and perceptible edema of the face and eyes, but the principal feature was the tremendous edema in the hind legs and spreading from them up to the thorax. Therapeutically, the dog which was near death from shock was enabled to live twenty-one and one-half hours.

Dog 360 (Summary of record). This was a female pup not quite grown. It weighed 8 kg.

Nembutal (180 mg.) was given at the beginning and no further anesthetic administered. Tourniquets were placed on both hind legs at 1:15 A.M. and removed at 10:15 A.M. (nine hours). The animal was conscious and apparently comfortable. By noon the red cell count had

injection the dog sat up and behaved almost normally, but at 12:35 P.M. it lay flat again. The animal drank 300 cc. of water. 1:35–1:55 P.M., injected 1200 cc. saline. Urine: 350 cc. at 1:20 P.M., 450 cc. at 2 P.M., and 210 cc. at 3 P.M., with the usual 1012 specific gravity.

TABLE I
DOG 267

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	7:45 A.M.	......	...	5.7	Nembutal 180 mg. Weight 15 lb. (6.8 kg.).
	8:15 A.M.	......	...	...	Hind legs ligated.
	11:30 A.M.	......	...	...	Nembutal 60 mg.
	2:45 P.M.	......	...	...	Tourniquets removed (6½ hr.).
	3 P.M.	......	...	8.0	
	6:30 P.M.	......	...	9.4	Nearly dying. Blood dark. Temp. 94°F.
	6:35 P.M.	200	...	...	Rapid injection, followed by slower continuous drip.
	6:45 P.M.	......	...	...	Awake, crying. Blood pressure unobtainable. Nembutal 60 mg.
	8 P.M.	......	...	8.5	Ear blood still dark, scanty.
	9:30 P.M.	......	340	...	Slight diarrhea.
	10:15 P.M.	......	300	6.9	Lightly asleep, strong.
	11:30 P.M.	......	500	5.7	Moderate diarrhea. Temp. 96°F.
2	12:30 A.M.	......	270	...	Weaker. Slight rattle in breathing. Infusion made slower.
	1:30 P.M.	......	120	5.5	Awake. Sits up. Drinks 200 cc. water, later 220 cc. more.
	3 P.M.	......	430	3.5	Stronger. Good respiration, 24 per min. Temp. 99°F. Blood brighter and more abundant.
	4:30	......	320	...	Stronger, requires tying. Drank 200 cc. water. Brachial pressure 136/74 (auscultation).
	5:30 P.M.	......	...	4.2	
	6:30 P.M.	4500 cc. total	300	...	Finished injection. Weight 20½ lb. (9.3 kg.). Able to walk.
	11 P.M.	......	...	3.4	Alert but weaker. Ear blood red, profuse.
	4 P.M.	......	...	2.1	Edema of face and body. Too weak to stand. Temp. 87°F.

Totals up to 6:30 A.M., 4500 cc. saline injected, 620 cc. water drunk, 2580 cc. urine. Lacrimation; bulging eyeballs.

In extreme weakness at 4 P.M., given transfusion of 200 cc. normal blood without anticoagulant, without benefit. Death. Immediate autopsy.

Congestion and edema of lungs. Usual gross findings with edema. Spleen normal size but very dark. Microscopic: "Lungs, frank consolidation by a fibrinopurulent exudate within bronchi and alveoli; there are a few isolated areas of hemorrhage. Spleen, extremely engorged pulp, normal follicles. Liver, kidney, adrenal normal."*

Oxalated samples were taken from blood of distended heart and from copious edema fluid of hind legs. Total protein 3.6 per cent in blood and 1.4 per cent in edema.

* All microscopic reports on tissues were by Dr. James R. Lisa, as mentioned later.

risen from the original 5.3 to 8.3 millions. The dog was conscious, not dying, but limp and inert in any position and entirely heedless during exposure of the right jugular vein. Between 12:05 and 12:20 P.M., 1,200 cc. saline were injected in vein. At the end of the

Red cells (millions): 3.8 at 1 P.M., 4.2 at 2:45 P.M. Rectal temperature 97°F.; there were coarse rales in the chest. Increasing weakness and convulsive twitching took place and death occurred at 3:30 P.M. Immediate autopsy showed the stomach to be very full of water,

the usual general wetness, congestion and edema of lungs and huge thigh edema. Examined microscopically, the adrenals and the grossly edematous pancreas were normal.

Here the circulation was overloaded with two sudden injections, each considerably larger

dose of nembutal. With the onset of shock after removal of the tourniquets, all the nembutal seemed to have a cumulative effect, resulting in dangerous unconsciousness with absent conjunctival reflex and very low temperature. There were no observations on blood pressure,

TABLE II
DOG 361. WEIGHT 5.5 KG.

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	9 A.M.	....	...	...	Nembutal 150 mg.
	9:15 A.M.	....	...	5.3	Both hind legs ligated. Water 100 cc. by stomach tube.
	9:30 A.M.	....	...	...	Nembutal 60 mg.
	2 P.M.	....	...	5.4	Nembutal 60 mg.
	2:15 P.M.	....	...	...	Tourniquets removed (5 hr.). Unconscious.
	2:20 to 2:35 P.M.	1000			
	2:50 P.M.	....	...	...	Deeply unconscious.* No conjunctival reflex. Slight diarrhea; very few cc. urine. Stomach tube yields 200 cc. clear fluid, neutral, NaCl = 0.676%.
	3:15 P.M.	....	100	4.1	Ear blood bright red, profuse. Conjunctival reflex returning. Stomach empty.
	6 P.M.	....	125	7.0	Still unconscious; good eye reflex. Temp. 93°F. in very warm room.
	6:30 to 6:40 P.M.	500	...	...	Wakes briefly. Temp. 94°F. Stomach empty.
	7:30 P.M.	....	250	4.2	Thirsty; not yet able to drink.
	8:30 P.M.	....	200	...	Water 100 cc. by stomach tube.
	9 to 9:15 P.M.	500			
	9:30 P.M.	....	...	...	Drinks 100 cc. water. Curls up in normal position to sleep.
	10:30 P.M.	....	Lost	4.8	Temp. 96°F. Responds to petting. Drinks 100 cc. water.
2	1:30 A.M.	500	Lost	5.1	Responsive. Drinks 100 cc. water.
	5 A.M.	....	Lost	4.2	Ear blood copious, thin, bright.
	8 A.M.	....	Lost	4.4	Stronger. Temp. 98°F.
	11 A.M.	....	Lost	4.7	Weakening. Apathetic.
	2 P.M.	....	...	...	Found dead.

Autopsy.   Heart nearly empty. Lungs normal. 50 cc. clear fluid in peritoneum, none in thorax. Spleen normal size but very dark mottled. Usual general wetness. Huge edema of hind legs. Microscopic. Lung, pancreas, liver normal. "Spleen: the pulp is deeply engorged but no other changes are evident. Kidney: most of the tubules contain an amorphous granular detritus. Adrenal: the cytoplasm of the reticular cells is foamy and pigment appears very scanty. The glomerular and fascicular zones appear normal. The medulla is normal."

than the estimated blood volume. The effect was necessarily injurious, but instead of a quick fatality the dog lived twenty-nine hours, i.e., several times as long as it could have lived untreated with the severe shock of a nine-hour ligation.

Dog 361 (Table II) first illustrates the danger from even a slight narcotic poisoning. Shortly before removal of the tourniquets the dog was crying, and was put to sleep with a fractional

but the oliguria may have been connected with hypotension. Diuresis increased as the narcosis passed off.

The fluid intake of 2,500 cc. saline and 500 cc. water amounted to more than one-half of the body weight. This treatment was started early, so that all important hemoconcentration was prevented and the blood was almost continuously dilute, as indicated by the slightly subnormal red cell counts. The survival for nearly

twenty-four hours after removal of the tourniquets is a multiple of what is possible after a five-hour ligation without treatment. The absence of pulmonary edema is noteworthy.

Dog 353 (Table III). As compared with dog 361 (Table II) this was a smaller saline injection

Dog 354 (Table IV), in the act of dying from shock, was restored by the saline infusion. Life was prolonged to the fifth day, and the vessels were filled with an apparently increased volume of dilute blood throughout this time. It was rather surprising that on the third day, with

TABLE III
DOG 253. WEIGHT 7 KG.

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	10 P.M.	...	...	5.7	Morphine 15 mg. subcut. Nembutal 180 mg. intraper.
	10:15 P.M.	...	...	...	Both hind legs ligated.
2	1:00 A.M.	...	...	...	Nembutal 60 mg.
	7:15 A.M.	...	...	6.4	Tourniquets removed (9 hr.). Awake, comfortable.
	8:30 A.M.	...	...	8.1	Lethargic; heedless of dissection of jugular. Blood dark. No immediate danger.
	8:35 to 8:50 P.M.	900	...	...	Sits up nearly normally.
	9:30 P.M.	...	...	5.5	Slight diarrhea. Ear blood profuse, bright red.
	10:30 P.M.	...	...	4.6	Stronger, more active. Heart 250. Drinks 150 cc. water; vomits.
	11:30 to 11:40 P.M.	600	170	4.9	Stronger. Heart 190. Drinks 500 cc. water; vomits.
	1:30 P.M.	...	...	4.7	Stronger. Heart 156. Drinks 550 cc. water in installments; retains it.
	4:00 P.M.	...	360	4.3	Drinks 400 cc. water.
	6:00 P.M.	...	280	3.9	Walks well except for paralysis and huge edema of hind legs.
	9:00 P.M.	...	310	4.1	Caged for night, in apparently good condition.
3	8:00 P.M.	...	Lost	4.2	Weak, but alert and responsive. Slight diarrhea.
	4:00 P.M.	...	Lost	4.4	Same. Ear blood less bright and copious.
4	10:00 A.M.	...	Lost	4.1	Extreme collapse. Died under observation.

Autopsy. Heart contracted and nearly empty. Dark blood clots quickly and firmly. Dark red engorgement and large edema of hind legs; blood-tinged edema over abdomen. Kidneys wet; other organs normal; no edema of lungs or pancreas; no fluid in peritoneum. No microscopic examination.

in a larger dog with more severe shock. The shock from a nine-hour ligation is rapidly fatal, but treatment was begun early before the condition was critical. The saline seemed mostly to be bound by the tissues, for free diuresis did not begin except with the drinking of 950 cc. of water. After the first saline injection, hemoconcentration was effectually prevented. As in the other experiments, here also the fluid did not continue to pour out of the vessels. The dog lived over fifty hours after removal of the tourniquet. The notable features are the extremely long survival with this very severe form of shock, and the dilution of the blood as indicated by subnormal red cell counts to the end.

marked hydremia present, the strength was distinctly improved by another infusion of 1,000 cc.

Distemper was prevalent in the laboratory. In the terminal stage the dog exhibited fever, pus in eyes and nose, diarrhea and typical rash on abdomen and groins. The pneumonia found at autopsy was of a degree which often causes death in normal dogs. This dog survived the ordinary period of shock, and apparently might have recovered completely except for distemper. Obviously the shock and the infusion may have increased susceptibility to the infection.

In order to learn what part of the results were due to shock, it was evidently desirable to

TABLE IV
DOG 354. WEIGHT 8 KG.

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
I	8:30 A.M.	....	....	4.6	Morphine 15 mg. subcut. Nembutal 180 mg. intraper.
	8:50 A.M.	....	....	...	Both hind legs ligated. Water 200 cc. by stomach tube.
	11 A.M.	....	....	...	Nembutal 60 mg.
	11:30 A.M.	....	....	...	Nembutal 60 mg.
	2:50 P.M.	....	....	4.7	Tourniquets removed (6 hr.).
	5:20 P.M.	....	....	9.0	Extremely dark scanty blood.
	5:50 P.M.	....	....	9.6	Complete apnea. Heart nearly failed.
	5:50 to 6:05 P.M.	1000	....	...	Heart and respiration restored. Unconscious; good conjunctival reflex.
	6:30 P.M.	....	140	4.7	Slight diarrhea. Ear blood bright red, profuse.
	7:15 P.M.	....	130	8.3	Jugular again poorly filled.
	7:20 to 7:35 P.M.	1000	....	...	Stronger. Slight diarrhea.
	8 P.M.	....	....	6.5	Notices surroundings.
	9 P.M.	....	600	5.8	Conscious, but too weak to move.
	9:30 to 9:45 P.M.	1000	....	...	Begins to move. No rales in chest.
	10:30	....	620	3.5	Stronger. Slight diarrhea.
2	2 A.M.	....	Abundant lost	4.6	Profuse bright thin ear blood. In cage.
	4:30 P.M.	....	Lost	5.1	Stronger. Drinks 300 cc. water.
	8:30 P.M.	....	Lost	5.7	Drinks 240 cc. water. Behaves normally except for swollen paralyzed legs.
	5 P.M.	....	Lost	4.9	Weaker. Drinks unmeasured water.
3	11 A.M.	....	Lost	3.6	Very weak. Barely sits up. Temp. 103°F. Labored respiration.
	12 to 12:15 P.M.	1000	250	...	Slightly stronger after infusion.
	1:30 P.M.	....	Lost	3.5	Stronger. Retains 200 cc. milk by stomach tube.
	5 P.M.	....	Lost	3.5	Ear blood profuse, thin, bright red. Edema from huge thighs over entire flanks and abdomen.
4	9 A.M.	....	Lost	3.3	Depressed and weak. Edema diminishing. Ear blood still profuse bright red. Milk 200 cc. by tube.
	8 P.M.	....	None	3.2	Milk 100 cc. by tube. Vomited. Temp. 103.6°F.
5	8 A.M.	....	120	...	Spec. grav. of urine 1020. Milk 200 cc. by tube. Weak. Temp. 99°F.
	6 P.M.	....	....	3.0	Has had small convulsive movements. When lifted, went into convulsion and died.

Autopsy. Heart and great vessels full of thin-appearing blood. Lungs slightly congested; left lower lobe intensely hepatized. Abdominal organs neg. Bone marrow pale. Edema of hind quarters much diminished but still large. Thigh muscles very dark, apparently from old blood pigment.

Microscopic: Lung (right); several foci in which alveoli are small and filled with edema fluid and a few red corpuscles. Most of the bronchi contain fresh hemorrhage and a small amount of edema fluid. Kidney; amorphous material in lumen of convoluted tubules; otherwise normal. Spleen; architecture preserved; prominent feature is lack of blood and moderately dilated capillary sinuses. Liver normal. Adrenal; medulla normal. Fascicular zone comprises most of cortex. Glomerular zone narrow, cells clear. Reticular cells, foamy, have little or no pigment. Thigh muscle; acute degeneration in fibers; marked edema in interstitial tissue; endothelial proliferation with a few monocytes and lymphocytes. An occasional artery has a hyalin thrombus.

carry out a similar procedure on normal dogs. This plan differs from all previous undertakings by Cutting and others, in that it seeks to avoid overwhelming the animals by a rapid overdose, and tries to allow maximum time for adjust-

and associates, which were killed acutely by about 700 cc. of 1 per cent sodium chloride solution per kg., infused at the rate of 5 cc. per kg. per minute, with a retention of 550 cc. per kg. The figures for the dog do not represent

TABLE V

DOG 373

Day of Experi- ment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	3:00 P.M.	....	....	5.6	Weight 11½ lb. (5.2 kg.). Morphine 20 mg. subcut. Nembutal 90 mg. intraper.
	4:00 P.M.	....	....	...	Saline infusion begun through cannula in right jugular.
	5:00 P.M.	500*			
	5:30 P.M.	....	460	...	Nembutal 60 mg. Awake, strong. Heart 90, resp. 20, temp. 97°F.
	6:30 P.M.	500			
	7:30 P.M.	500	620	4.4	
	8:30 P.M.	500	....	...	Restless. Morphine 8 mg. subcut.
	9:15 P.M.	500	..✦	...	Mucous rales. Infusion slowed temporarily.
	10:15 P.M.	500	1040	5.9	
	11:00 P.M.	500	....	...	Rales and dyspnea increased. Heart weaker.
	11:45 P.M.	500			
2	12:15 A.M.	....	510	...	Temp. 96°F. Resp. 20, puffing. Heart 140, too weak to count except by auscultation. No rales. Extreme weakness. Dribbling urine. Gray liquid diarrhea. Conjunctival reflex present; anal sphincter relaxed. Watery fluid drips from nose, but stomach tube yields only 25 cc. thick mucus.
	12:30 A.M.	500	30	...	Nearly dying. General swelling of body. Abdomen distended and tender. Infusion ended. Body weight 15¼ lb. (6.9 kg.).
	1:15 A.M.	....	....	6.8	Edema of eyelids.
	2:10 A.M.	....	140	...	Heart and respiration feeble.
	3:00 A.M.	....	....	...	Death after gradual choking.
		Saline total 4500	Urine total 2860 cc. with 90 cc. watery feces.		

Autopsy. Heart distended. Lungs edematous. Peritoneum distended with large ascites. Liver dark, not specially large, congested or wet. Spleen dark, not enlarged. Kidneys congested and wet. Adrenals normal. Pancreas not markedly edematous. Microscopic: Kidney normal. Liver; entire capillary bed is extremely engorged. Adrenal; medulla normal. Cortical zone narrow, no definite pathology.

* The infusion was continuous. Each figure for saline is the quantity given in the period ending at that hour.

ment by slow or spaced injections over several hours.

Dog 373 (Table v) was a normal male which received approximately 900 cc. of 0.85 per cent sodium chloride solution per kg. during eight and one-half hours, and died two and one-half hours afterward. The longer time interval, therefore, did not give a very great advantage to this dog as compared with the cats of Cutting

a minimum lethal dose, because it seemed evident that if the infusion had been stopped earlier, death would still have occurred after a longer time.

Some dilution of the blood occurred at first, as anticipated. The rising corpuscle counts toward the close are not understood. It may be argued that the large saline infusion caused shock by washing protein out of the circulation,

but the seemingly increased blood volume which distended the heart at autopsy is hard to reconcile with the corpuscle counts. Repetition would be necessary to exclude accidental local changes in the ear blood with the failing general circulation in this one animal.

Dog 408, female, not quite grown, weighing 12 pounds (5.45 kg.), was kept quiet but conscious with very small sedative doses of nembutal and morphine, and received 0.85 per cent sodium chloride solution intravenously as follows: 10 A.M., 400 cc.; 11 A.M., 400 cc.; 12:15 P.M., 400 cc.; 4:45 P.M., 500 cc.; 6 P.M., 500 cc. The urine totalled 870 cc. The body weight was increased to 14¼ pounds (6.48 kg.). The body looked swollen, and the dog was groaning and dyspneic because of a large tense ascites. Next day the dog acted well, the ascites was gone and the weight was 11 pounds (510 kg.). Red cell counts, in millions, were: before the experiment 4.9; 10:55 A.M., 4.6; 12:10 P.M., 5.4; 4:15 P.M., 4.8; 8:30 P.M., 3.6; next day, 5.1.

Here the injection of 400 cc. saline per kg. during eight hours produced signs indicating a near approach to the limit of safety, which together with a very marked blood dilution lasted more than two and one-half hours after the final injection. Three differences from shocked animals were noticed, namely, the earlier and more marked ascites, the more rapid restoration of a normal blood count, and the refusal to drink water at any stage.

REMARKS

In the absence of organic disease, the tolerance limit for physiological saline solution is evidently high. Cutting and associates pointed out that a tolerated dosage of 500 cc. per kg. in cats would correspond to 35 liters for a 70-kg. man, infused as rapidly as 350 cc. per minute. The tolerance for hypertonic salt solution or for glucose solution is lower. Cutter recommended an actual infusion rate of 20 to 40 cc. per minute for patients in shock. Conservatism in clinical trials is suggested by the fact that human beings are more subject to edema than cats or dogs.

To assess the influence of shock, a comparison may be made between the shocked dog 267 (Table I) and the normal dog 373 (Table v), which received the identical dose of 4,500 cc. of saline. The former dog being slightly larger, this infusion equalled about two-thirds of the body weight, while in the normal dog it was nearer to five-sixths of the body weight. But the drinking of 620 cc. of water by the shocked dog raised the total intake to about three-fourths of the body weight. The net result was that the fluid retention was not far from one-third of the body weight in each animal. The infusion occupied twelve hours in the shocked dog and only eight and one-half hours in the normal dog, but as the shocked one was near death when the infusion started, the result is highly creditable to both its diuretic function and circulatory adaptation.

The immediate therapeutic effects of large saline infusions in shock are spectacular. Inasmuch as circumstances did not permit of setting up apparatus for the elaborate records which critics might demand, the plan was adopted of letting at least one animal in each class of experiments reach the point of death. Death in shock always occurs by apnea, while the heart beats strongly and then fades out. This fact seems to fit poorly with Wiggers' suggestion of a primary cardiac factor in the fatality, especially when allowance must be made for some impairment of heart function by anoxia. The evidence of the degree of shock in these experiments is furnished by the corpuscle counts, and by waiting until the breathing has stopped and sometimes until the heart action has almost ceased (Dog 354, Table IV). This test in any form of true shock (not acute hemorrhage) is believed to be not only decisive proof of the final stage but also a more extreme standard than any other investigator has ventured to set up for any form of therapy. The uniform result is that the saline infusion restores life. As long as any effective flicker of heart action remains, the salt solution together with artificial respiration and some massage of the thorax is successful, without a failure or exception.

As the infusion continues or the large injections are repeated, the shrunken blood

vessels become filled or distended to such a point that a nick in an ear vein may start a veritable hemorrhage. The correction of anoxemia can be affirmed positively even without oxygen analyses, because the dark purplish blood not only regains normal color but also goes on to a point at which the venous blood is almost as bright tinted as ordinary arterial blood. Hemoconcentration is replaced by a dilution of the blood, in the sense of subnormal corpuscle content and also the reduction of plasma protein to be described later.

Mention may be made here of a few incidental observations. One atypical dog gave a series of red cell counts only between 6 and 7 millions when the clinical signs indicated a nearly terminal state, and then the injection of 250 cc. of saline suddenly raised the count to around 9 million, the evident interpretation being the opening of dammed-up capillaries to release packed corpuscles. In contrast to the reports of delayed clotting in shock, cursory examinations of blood from ear veins and autopsies of injected animals indicate an approximately normal clotting time, though the coagulum in the dilute blood is scanty and pale. Consciousness returns more or less rapidly, as shown in the various protocols. Cutting and associates reported absence of any marked elevation of blood pressure in normal animals, and workers with smaller injections have obtained only slight or transitory elevations in shock. In severe shock no sounds are audible with the auscultatory method, but scattered observations show that the large infusions produce well sustained elevations to normal levels or above, and the sounds are clear and sharp. Sufficient evidence on this point seems to be furnished by the abundant diuresis which is the rule after the tissue needs are satisfied, if narcotic poisoning is absent. Isosthenuria is practically invariable during the injections, the specific gravity being monotonously fixed at 1012–1014, though the retention of kidney function is indicated by lower figures sometimes with copious water drinking or higher

figures near the beginning or after the end of the injections.

As there are not the albumin, casts or renal disorders of nephritis or nephrosis, the condition is chiefly comparable with the hydremia and edema of avitaminosis and malnutrition. Somehow a new equilibrium becomes established lasting at least for a term of days. Blood volumes are among the many obvious and necessary studies which could not be made, but supervolemia is plainly suggested by the copious thin bleedings from the ear veins. Anemia is a probable concomitant because of the blood loss with some (and possibly to some degree with all) of the shock methods in this investigation. The regeneration of plasma proteins being reported as retarded in shock (Ebert et al.), the question is open how this process and also corpuscle formation behave under the infusion treatment. The apparently rapid recovery of the blood under the most successful treatment encourages the hope that neither the leg ligations nor the infusions have much anemic effect. This question might be studied further with shock produced by injection of a colloid such as dextrin which presumably does not destroy erythrocytes.

Large scale injections of any markedly hypertonic salt solution are obviously a therapeutic impossibility, unless very copious drinking is feasible. The surprising amount of water drinking shown in the tables might create the suspicion that all the saline injections were hypertonic, but the following incidental comparisons were made. The shocked animals were thirsty when injected with 0.9 per cent sodium chloride, 0.85 per cent sodium chloride, Ringer solution, or (to less degree) plasma. Normal dogs receiving similar saline injections refused water. One possible explanation is that traumatic exudation creates thirst, like a hemorrhage; the untreated animal is too apathetic and too limited in absorptive power to drink much, but after treatment the needed water can be taken. Beyond this, however, is the apparent fact that thirst is greatest with

the largest saline injections. Therefore, the solution being isotonic but not isoionic with the body fluids, shocked dogs seem to differ from normal dogs in having some unexplained need for water to adjust their ionic equilibrium. Hypotonic injections were not tried. Frequently, however, solutions were made up crudely with one flat teaspoon of table salt to a pint of tap water, and notwithstanding the huge volumes the results were indistinguishable from those with a precisely weighed amount of pure salt in distilled water. It may be of practical importance to understand that in emergencies a hasty makeshift preparation of salt solution is (except for possible pyrogens) permissible and harmless in shock treatment.

The opposite process of eliminating fluid through the stomach is one of the dangers of the largest injections, as the Cutting group mentioned. Up to a very high limit of infusion the stomach remains empty except for a mere trifle of mucus. But if the overloading of the circulation becomes too extreme, there seems to be a rather sudden flooding of the stomach with watery liquid, suggesting reverse peristalsis from the intestine. An animal may save itself if able to vomit, but the accident mostly occurs in those which are too weak or unconscious, especially with excessive narcosis. Regurgitation and fatal aspiration into the lungs are then not noticed until too late, and a number of experiments were thus spoiled until the lesson of making watchful use of the stomach tube was learned.

The ability of animals at the point of death to withstand the circulatory overload with actual benefit for such long periods seems to furnish positive proof of either normal function or quick recuperation of the heart, vessels and vasomotor system. But in spite of the dramatic initial improvement, none of these over-flooded animals finally recovered. The cats studied by the Cutting group showed no such prolonged edema, hydremia or fatal course. If the saline infusion was

stopped just short of a certain sharp end-point, within twenty-four hours all of the salt and 80 per cent of the water had been eliminated by the kidneys. This might imply a critical disturbance created by the shock, but the Cutting infusions were finished within two hours, and my fatal experiment with a normal dog indicated that when the fluid overload is continued for over eight hours, the animal may die even more quickly than the shocked animals. The facts of present importance seem to be, (1) that the animal in advanced shock retains a tolerance for salt solution fully equal to that of a normal animal; (2) that the fatal process after excessive saline is opposite to shock in such cardinal features as hemoconcentration (replaced by dilution), oligemia (volume becoming supernormal), and anoxemia and anoxia (the venous blood showing bright red superoxygenation, and the clinical improvement showing utilization of the oxygen).

It has been possible to save space by abbreviating the gross autopsy reports, because all details were precisely as described by the Cutting group. The general evidences of excess fluid are broadly similar in the shocked and the normal animals, and the extreme edema of the pancreas is frequent in both series. Cutting and associates found an invariable absence of brain edema, and examination of the central nervous organs was omitted in my animals notwithstanding the occasional twitchings or slight convulsions. This central nervous immunity may be lacking in man because of the greater tendency to edema.

The lungs are the weakest point in the circulation and the most acute deaths are from pulmonary edema. The lung engorgement and edema, described by Moon and authors whom he cites, raise a particularly interesting question. Since the animal dying from shock has lungs already in this condition, what will be the effect of a saline infusion large enough to endanger the lungs of a normal animal? In addition to the great and obvious improvement in

respiration, the autopsies corroborate the statement of Davis that the tendency to lung edema is reduced in traumatic shock. The shocked animal likewise has comparatively little effusion in the peritoneum or other serous cavities. The normal animal must dispose of fluid in some such desperate manner, but in shock the traumatized area constitutes a point of least resistance or a dumping place for fluid, which acts as a safety valve for the circulation. Hence the traumatized limbs acquire a prodigious edema, beyond comparison with anything ever seen without infusions, and this fluid migrates for long distances under the skin of neighboring parts. Because of the inflammation and capillary injury the swelling in the traumatized parts naturally requires several days to clear up by absorption.

These facts have also a theoretical significance. Supporters of the purely physical theory may argue: The symptoms of extreme shock are relieved by a mere fluid supply, therefore, there is no toxin. More especially, abnormal capillary permeability can be demonstrated by easier and more copious outpouring of fluid. This increase of permeability is strikingly demonstrated in the traumatized parts, but in the rest of the body there is no increase as compared with normal animals. The upholders of the chemical or toxic theory may still maintain that local metabolites cause or contribute to the capillary phenomena in the damaged parts, and that these substances become distributed through the body and set up similar but slighter capillary changes. Whatever the cause of the shock state, it is either cured or compensated by a sufficient supply of salt solution. The remedy evidently takes the form of a new fluid equilibrium between blood and tissues. This equilibrium is reached not only throughout the general circulation but also in the traumatized parts where the capillary damage is extreme and undeniable. It is demonstrably false that the damaged capillaries continue to pour out fluid indefinitely even though the

blood is diluted in cells and protein. Each additional saline injection breaks the equilibrium and causes an increment of edema in the traumatized area, but the stopping of the infusion is soon followed by a stopping of edema formation and later by absorption. Everybody is agreed that death from shock is due to anoxia and not toxemia. The saline injections do not necessarily decide between the two theoretical conceptions of the cause of shock, but they may offer a new approach to the problem.

The previously mentioned evidence indicated that the treated animals died not from shock but from the treatment. If the treatment should be a specific and infallible cure of shock, there is no proof that a patient could stand the severest treatment that might be needed for the severest shock. But even if fatal, the large saline infusions at least gain time by preserving life through the most acute shock period, and there is the possibility that an antidote to the treatment may then be easier to find than a cure of the original shock. Restoration of the normal blood composition is an obvious undertaking, either along with the saline infusion (perhaps with dilute plasma) or subsequently (perhaps with concentrated plasma). The dogs did not have the benefit of any real trials of supplementary treatment. A few small transfusions, attempted in the ultimate stage, necessarily failed. The fallacious theory of withdrawing water from the tissues by hypertonic saline injections proved acutely fatal in tests. Drugs, hormones and other possibilities suggest themselves, if it is ever necessary to use massive infusions which threaten life in uncomplicated or especially in complicated cases.

CONCLUSION

The only conclusion drawn at this stage will be of preliminary but sweeping character, namely, that shock is reversible at all stages. It has been explained that this result does not imply saving of life in

all cases, though a later paper will give examples of the reversal with quantities of fluid which are compatible with permanent recovery, in shock produced by the same and various other methods. This partial publication, leaving references and various details to be supplied later, has seemed advisable in the existing war emergency, because the experiments if confirmed may suggest clinical trials in cases of shock which are hopeless under present methods.

THE normal mode of absorption from the bowel is through its mesentery and may occur by the lymphatics or through the mesenteric radicles of the portal vein. In addition it is believed that under conditions of obstruction, transperitoneal absorption through the bowel wall itself may obtain also.

IMPROVED TECHNIC FOR BLIND NAILING OF THE NECK OF THE FEMUR

THE CRECCA-CETRULO GUIDE

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SINCE Ambroise Pare's (1530) historical report of fracture of the neck of the femur, medical science has been seeking a solution to this difficult and, as

May, the Groves and the Littig. Each of these has its merits but is lacking in either facility of application or in accuracy of position in all fractures.
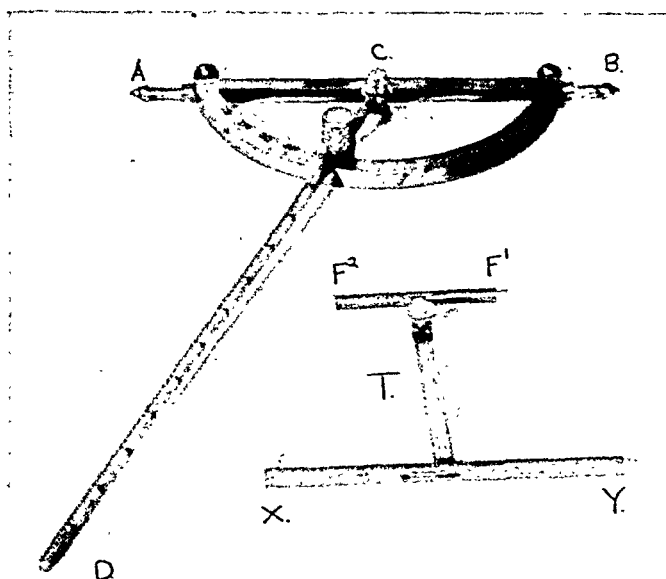
FIG. 1. The Crecca-Cetrulo guide. Calibrated axial (c-d), pivoting on protractor. Adjustable pointers (a-b) for anterior-superior-spine and symphysis pubis. Accessory part (t) which slides (x-y) over axial rod with parallel ferrule (f1-f2) for 3/32 pin. f1 is set against central point of shaft about 1/2 inch below inferior border (ridge) of lateral aspect of greater trochanter.

has been previously stated, "unsolved fracture."

Smith-Petersen's introduction of the three flanged nail ushered in an era of ingenious approaches to this problem. Contributions among others by Sven Johanssen of Sweden (1932) and Wescott of Virginia (1932) served to improve the original technic by introducing blind nailing. Since then several types of guides for nailing have been introduced, notably, the Bailey, the Engel-

The other guides all seek, in one means or another, to direct a Steinman pin or nail in a certain plane but fail to give a three dimensional adjustment necessary for accuracy.

The authors present a guide which is based on fixed anatomical landmarks assuring tridimensional accuracy as revealed in anterioposterior and lateral planes. The variable adjustments required for different degrees of depth and angulation are taken

93
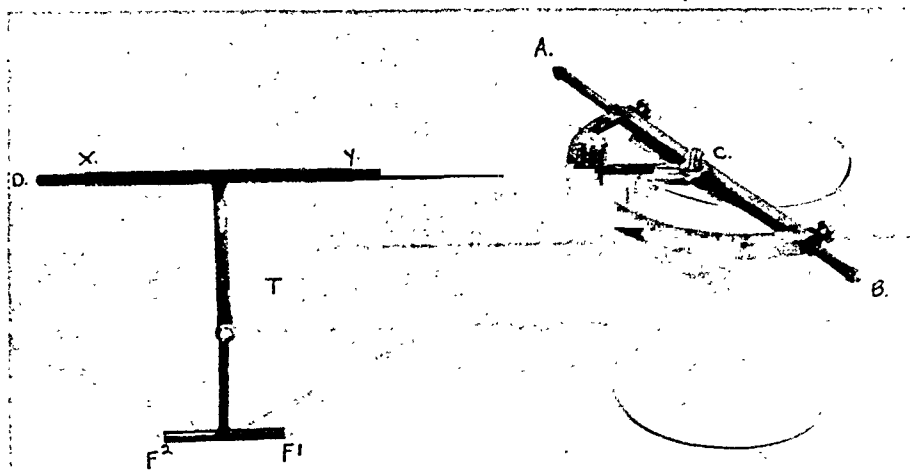
FIG. 2. Guide showing pointers (A-B), axial rod (C-D) and accessory part (T) with ferrule (F¹-F²) and sliding casing (X-Y).

FIG. 3.
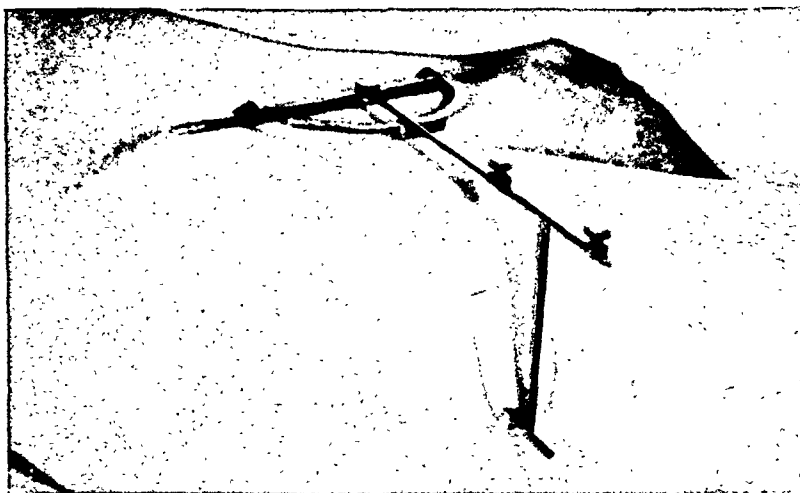
FIG. 4.
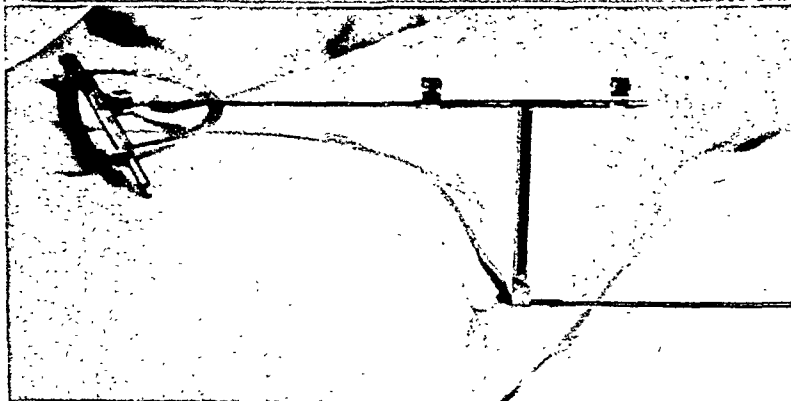
FIG. 3. Lateral view on patient showing position of guide prior to operation.
FIG. 4. Lateral view on patient showing guide in position with $\frac{3}{32}$ Steinman pin in ferrule.

into full consideration. The ease of application and adjustment of this guide insures accuracy and facilitates quick insertion of the nail.

Cetrulo guide are: (1) Anteriosuperior spine; (2) spine of the pubis and symphysis-pubis; (3) the inferior border (ridge) of the lateral aspect of the greater trochanter.

Fig. 5.

Fig. 6.

Fig. 5. Lateral view of Crecca-Cetrulo guide on skeleton showing leg parallel to floor and in internal rotation (20 degrees). Neck is on horizontal plane. The ("т") guide slides upward to position of circle.

Fig. 6. Roentgenographic lateral view of skeleton showing guide in position prior to drilling—$^3\!\!/_{32}$ pin. Direction of ferrule points through center of neck.

Purpose. The authors' aim is to facilitate the technical problem of inserting a Smith-Petersen (Johansson) nail under favorable and accurate operating conditions. The method presented by the authors (1) eliminates opening of the hip joint, (2) avoids possible injury to vessels, (3) insures accuracy of reduction and fixation, and (4) shortens the operating time.

Landmarks. The land marks essential for the proper application of the Crecca-

Principle. 1. In a normal pelvis a line (5 to 5½ inches) drawn between the anterio-superior spine and the symphysis-pubis crosses the acetabulum and, correspondingly, the head of the femur. The midpoint of this line corresponds to the central point of the head of the femur.

If instead, a line (4 to 4½ inches) from the anterio-superior spine to the spine of the pubis is used, the head of the femur is

from ½ to ¾ of an inch more medial on this same line.

2. An imaginary line ¾ to ⅝ inches from

at 20 degree internal rotation, the neck lies on a horizontal plane. Any slight variation will be revealed by radiograph.
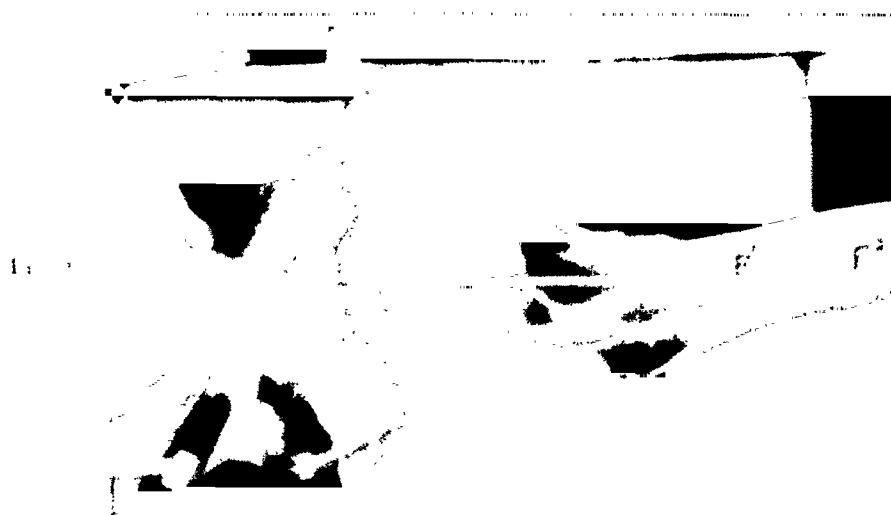
Fig. 7. Lateral view showing ³/₃₂ pin drilled through ferrule. Note parallel plane of neck, pin and axial rod.

Fig. 8. Same as Figure 7 in anteroposterior view.

the midpoint of the "anteriosuperior spine-symphysis-pubis line to a point ³⁄₄ of an inch below the inferior border (ridge) of the greater trochanter represents the optimum direction for nailing.

3. The angle formed by the junction of these two lines (at a point over the head of the femur) varies between 95 and 120 degrees depending upon the amount of abduction.

4. With the leg set parallel to the floor or the table and fixed to the Hawley foot piece

Equipment. The equipment consists of (1) a Hawley table with provision for fluoroscopy or x-ray; (2) canalized Smith-Petersen nail (Johansson), impactor and accessories; (3) box for sliding cassette in place; (4) drill and calibrated Steinman pin (³⁄₃₂); (5) surgical set-up for simple incision and exposure, and (6) Crecca-Centrulo guide. (Figs. 1 and 2.)

Technic. This involves (1) Spinal or intravenous pentathol anesthesia; (2) placement of box for cassette underneath

patient's buttock; (3) reduction by Lead-better technic, i.e., flexion of the thigh, traction in the axis of the thigh and

of the greater trochanter and 2 inches below.

Expose shaft of femur at this point,

FIG. 9. Roentgenographic anteroposterior view of guide with pointer at pubic spine.

FIG. 10. Smith-Petersen nail, Johannson type, being driven home after use of guide.

internal rotation, extension and abduction of the leg. (Palm test: roentgenogram is taken to determine proper reduction.) (4) Patient's foot is strapped to Hawley table (foot piece) with *the leg in internal rotation* (*about 20 degrees*). *Leg must be parallel* to the table or floor and in fixed position. (5) surgical preparation of the field; area includes lower part of abdomen and thigh; (6) set Crecca-Cetrulo guide (Figs. 3 and 4) from anterosuperior spine to spine of pubis and fix guide in position with skin clips at both spines. Set central point of axial rod $3⁄4$ of an inch from midpoint of anterosuperior spine–pubis spine line. Set end of axial rod to cross a point $3⁄4$ of an inch below inferior border (ridge) of greater trochanter; note calibrations on axial rod; (7) fluoroscope or take roentgenogram with guide in above position. (Fig. 9.) If direction is perfect, proceed otherwise adjust guide accordingly. (8) Make a lateral incision 3 inches long, one inch above the inferior border (ridge) of the lateral aspect

spreading fibers of tensor fascia lata and vastus lateralis. One important vessel will be encountered (this should be spread, if possible because of its value to hip joint)— the ascending branch of the lateral circumflex of the profunda on its way to the crucial anastomosis with the gluteal, deep circumflex and medical circumflex.

Feel with the index finger over the anterior and posterior aspects of the femur to ascertain thickness of shaft. Now find the midpoint of shaft ($3⁄4$ of an inch below the inferior ridge of trochanter) and fix accessory part of guide "T" to this point.

This is done by sliding accessory part of guide (Fig. 5) on the axial rod so that the accessory ("T") *parallels* the axial rod and the table. Then the lower end of accessory ("T") makes contact with the middle of the shaft at this point. A lateral roentgenogram of the neck with a plate between the legs will reveal the direction of ferrule of ("T"). (Fig. 6.)

SULFADIAZINE ANURIA

ITS RELIEF BY URETEROPYELOSTOMY

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THE dangers of grave drug reactions during sulfonamide therapy have been voluminously recorded and, particularly in recent literature, many instances of sulfonamide anuria have been reported.[1] In about a third of these patients the anuria was treated by forced fluid intake and often, in addition, by urinary alkalinization. In the remaining two-thirds increased fluid intake and ureteral catheterization, with or without ureteropelvic lavage, were employed. Yet approximately 30 per cent of all patients with sulfonamide anuria died in uremia, with or without other manifestations of sulfonamide ill effect.

Surgical renal decapsulation has been suggested as a method of improving urinary drainage through renal tubules occluded by acetylsulfonamide crystals but this does not relieve crystalline blockage of the pelves or ureters. Failing in achieving such relief by the ureteral catheter, there should be no delay in the establishment of free renal drainage by pyelostomy, ureterostomy or combined pyeloureterostomy. The site of upper urinary tract incision should be proximal to the uppermost obstruction. The beneficial practical application of this dictum is illustrated in the following report of a patient moribund in anuria, whose life was saved by unilateral ureteropyelostomy, etc. With unilateral restoration of renal drainage, uremia gradually disappeared and one week later free drainage of the opposite kidney was achieved by cystoscopic manipulation. While it is possible that the treatment of this patient is not unique, careful search of the literature has failed to reveal a parallel instance; our striking success in an apparently hopeless situation may suggest to and encourage others in the employment of this procedure when indicated.

CASE REPORT

W. W., age forty-seven, a white chef, was admitted to the Montclair (New Jersey) Community Hospital on April 30, 1942, complaining of severe abdominal pain which began seventy-two hours previously and during the past twenty-four hours was accompanied by chills and fever. There had been some nausea but no vomiting. The patient stated he had been coughing for several days and complained of sore throat, as well as some pain and tenderness in the right lower chest and axillary region.

During the past several years the patient had suffered gastric distress with epigastric pain several hours after eating, most severe during the winter months, and these upsets were occasionally accompanied by black stools. For this he had been under treatment by another physician whose diagnosis, said to have been confirmed by radiographic studies, had been gastric ulcer and "nervous stomach." These symptoms recurred acutely three days before present hospital admission, increasing in intensity; one black stool was passed.

In the past varicosities of the left leg had been treated by injection. More recently, severe dental infection had been treated by local drainage and by several extractions.

Upon admission to the hospital the temperature was 102.4°F., the pulse was 82, the respirations were 22 per minute and examination by one of us (J. H. F.) disclosed right lower abdominal pain which was not sharply localized. The nasopharynx was moderately injected and there were small slightly tender palpable cervical glands. There was tenderness in the right lower chest and in the right axillary region. Thoracic examination disclosed no abnormality by percussion but the breath

sounds were slightly diminished over the right lower chest area in the midaxillary line; elsewhere the breath sounds were variably harsh. There was no change in tactile fremitus. The cardiac examination revealed no abnormality. The left abdomen was soft but there was muscle spasm on the right, most marked in the right lower quadrant. There was acute tenderness in the right flank. The liver and spleen were not palpable. Urinalysis showed 3 to 4 leucocytes per high power field. The blood count was as follows: hemoglobin 92 per cent; erythrocytes 3,760,000; leucocytes 16,450; neutrophiles 78 per cent; lymphocytes 14 per cent; monocytes 8 per cent. Schilling Index: Segmented forms 62 per cent; band forms 9 per cent; young forms 7 per cent.

Despite the respiratory infection, acute appendicitis was at first suspected but within four hours after admission to the hospital the abdominal pain localized along the course of the left colon although discomfort in the right lower chest persisted. A tentative diagnosis of nasopharyngitis, pleuritis and gastrointestinal infection was made. The nasopharyngeal infection was treated by the administration of codeine and aspirin and throat sprays. In addition, on April 30th, the day of admission, the patient received an initial dose of 2 Gm. (30 gr.) of sulfadiazine which was continued in doses of 1 Gm. (15 gr. each) every three hours; this was continued until May 5th.

On May 1st, the blood count showed 16,850 leucocytes of which 77 per cent were neutrophiles; 19 per cent were lymphocytes and 4 per cent were monocytes. Schilling Index: segmented forms 55 per cent, band forms 19 per cent, young forms 3 per cent. The sulfadiazine blood level was 2.3 mg. per cent. Sulfadiazine crystals appeared in the urine within twenty-four hours after this therapy was begun but the urinalysis was otherwise normal. The patient now complained of severe pain in the right chest. There was some dullness at the right pulmonary base but no râles were heard. The diagnosis of pleurisy and localized pneumonitis was made. The fluid intake was 3,980 cc. and the urinary output was 2,040 cc. during the first twenty-four hour period in the hospital. During succeeding days an increased fluid intake was maintained chiefly by intravenous infusions of normal saline—5 per cent glucose solution.

On May 3rd, his pulmonary and abdominal condition seemed improved. Fluids were given intravenously and by mouth to the extent of 3,100 cc. but the urinary output dropped to 950 cc. Sulfadiazine blood level was 2.7 mg. per cent.

On May 4th, the fluid intake was 3,150 cc. and the urine output was 1,820 cc. Sulfadiazine crystals continued present in the urine. The highest temperature on this day was 100°F. A roentgenographic study of the chest showed clear pulmonic fields.

On May 5th, the sixth day of the illness, the fluid intake was 2,200 cc. The patient complained of pain in the left loin and difficulty in urination. Later in the day he could not void at all. He was catheterized and 180 cc. of turbid urine was recovered. Sulfadiazine was discontinued; a total of 465 gr. (31 Gm) had been administered during the six-day period.

The patient became anuric, nauseated, distended and vomited repeatedly. On May 7th, the urethral catheter returned nothing. Marked edema of the face developed and his condition rapidly became exceedingly critical. On the afternoon of May 7th, one of us (M. F. C.) was called in consultation. The diagnosis of sulfadiazine anuria with advanced uremia was made and immediate ureteral catheterization was advised. That morning the patient's reaction was sluggish and that evening he was unresponsive and essentially moribund. A plain x-ray of the urinary tract showed no shadows indicative of calculus.

That night cystoscopy was carried out under light nitrous-oxide-oxygen analgesia (M. F. C.). The bladder was found empty; the bladder picture was that of generalized congestive cystitis with the bladder floor deeply covered with acetylsulfadiazine crystals. Numerous crystalline clumps were adherent to the bladder wall and dome. Projecting from each ureteral orifice was a large dense crystalline cluster which, on the left side, could not be budged. On the right side, the extruding crystalline mass was broken away and, with great difficulty and while a steady stream of sterile water was being injected through the ureteral catheter, it was finally possible to wash away enough crystalline débris from the lower ureter to permit passage of the catheter 1 cm. up the duct. Higher than this it would not go. For the benefit of those who have never attempted to pass a ureteral catheter up a ureter firmly blocked with acetylsulfonamide

crystals, it should be noted that as the catheter breaks down the larger crystalline clusters in the duct, the pulverized particles become even more densely packed and offer even greater resistance. The purpose of the continuous irrigation of the ureteral catheter, though fruitless in this case, was to wash away this crystalline débris as it was broken up within the ureter.

Because of the patient's perilous condition he was immediately sent to the operating room for direct drainage of his right kidney pelvis. There was no succinct reason for selecting the right kidney over the left except that he had more recently been suffering pain attributable to the right.

Right ureteropyelostomy (M. F. C.; J. H. F. assisting). Under nitrous-oxide-oxygen analgesia the lower pole of the right kidney was exposed through a curved loin incision, and was mobilized sufficient to permit visualization of the upper ureter and adjacent renal pelvis. The ureter was found tightly packed with acetysulfadiazine crystals, giving it a pipe-stem effect. A longitudinal incision 1.5 cm. long was made in the upper ureter at the junction of the renal pelvis; this liberated a small amount of extremely cloudy urine and some crystals. A No. 20 French two-eye catheter was passed into the kidney pelvis, the pelvis was well irrigated with saline, and the catheter was fastened by one fine chromic catgut suture to the ureteral muscularis and sheath. Decapsulation of the greatly congested kidney was performed without further mobilization of the organ from its bed. Three cigarette drains were carried down to the ureteropelvic opening and the muscle and fascia of the loin wall were approximated with a double layer of No. 2 continuous chromic gut suture. The skin and external fascia were closed with interrupted deep dermal sutures. By an additional suture the catheter was anchored firmly to the skin margin.

Postoperative an intravenous infusion of 1,500 cc. of saline-glucose solution was given. Nausea and vomiting stopped. Strikingly, in the first six hours postoperatively, the right kidney excreted 1,450 cc. of urine and the following twelve hours excreted 2,500 cc. more; subsequently a normal fluid balance was maintained. Gradually, the uremic manifestations disappeared and forty-eight hours postoperatively the patient was thoroughly alert. The day following operation the blood sugar

estimation was 107 mg. per 100 cc., non-protein nitrogen 62.8 mg., chlorides 462 mg., and carbon dioxide combining power 54 volumes per cent.

Two days postoperatively the patient complained of vesical fullness with inability to urinate. Catheterization withdrew 180 cc. of dark brown urine; the catheter was then maintained indwelling for three days.

On May 10th, three days postoperatively, thrombophlebitis of the left leg was evident. This responded rapidly to immobilization and hot wet dressings; sodium thiosulfate was given intravenously (10 cc. of a 10 per cent solution). Yet abdominal distention and diarrhea caused the patient his chief postoperative distress.

As the urinary excretion through the indwelling catheter increased and the right renal drainage tube maintained approximately its former output, it was believed that left ureteral drainage had spontaneously been established. In order to make sure of this and to estimate left renal function, cystoscopy was again performed (M. F. C.). It was now possible to pass catheter to the left kidney pelvis and, by irrigation, remove a large amount of acetyl-sulfadiazine crystal débris. The right ureter was likewise catheterized and lavaged. Marked edema of the prostate and vesical outlet explained the patient's urinary difficulty; the urethral catheter was left indwelling for one week following the cystoscopy. Also following cystoscopy the output from the catheter in the right kidney dropped considerably as the left kidney resumed normal activity. The following day the right drainage tube was removed. Urinary drainage persisted through the wound for two weeks.

Two days after the second cystoscopy and, appearing with sharp onset, bronchopneumonia involved the right lower lung. This was successfully treated by Dr. George Henshaw who declined to employ sulfonamide therapy because of the patient's recent experience. On May 23rd, a mild secondary pneumonic process involved both pulmonary apices, more marked on the left. He was discharged from the hospital on June 1st with a clear chest and notably free of intestinal disturbance. A subsequent complete gastrointestinal radiographic study showed no abnormality. For several weeks following his discharge from the hospital, a Staphylococcus aureus urinary infection per-

sisted but was eventually eradicated by mandelic acid therapy as evidenced by two sterile cultures. An excretory urographic study made three months later showed no abnormality except a slight right ureteral irregularity just below the pelvic outlet.

REMARKS

Although we appreciate that in certain instances acetylsulfonamide anuria may result solely from occlusion of the renal tubules, clinical and postmortem observations suggest that ureteral and pelvic blockage by crystal deposit is more often fatal and, therefore, merits the greater consideration. When, as in our case, ureteral catheterization is technically impossible, no time should be lost in establishing free urinary drainage by opening the renal pelvis or the adjacent upper ureter and well above any crystalline obstruction. By employing this procedure, the pelvis can be evacuated of crystals, restoration of renal function is likely to be prompt, the operation does not require extensive renal mobilization, and in our opinion is definitely less traumatic to the kidney, already severely injured by obstruction, than nephrostomy—a point of special physiologic importance in all types of anuria.

The appearance of acetylsulfonamide crystals in the urine despite a relatively low blood concentration of the sulfadiazine confirms observations of others that there is little relation between the dose administered and the deposition of crystals. It is notable that, as in the case here reported, the radiographic studies are likely to be of little aid as the acetylsulfonamide crystals are rarely demonstrable by this means. In retrospect, it is possible that the alkalinization of the urine upon the early appearance of acetylsulfadiazine crystals in the urine might have prevented formation of subsequent crystalline masses but this is debatable. Similarly, earlier withdrawal of the drug might have prevented complete bilateral ureteral blockage but the medication was not stopped because the drug was combatting the initial disease so successfully. Moreover, the ultimate obstructive complication could not be foreseen.

SUMMARY

A case of sulfadiazine anuria is reported in which the establishment of urinary drainage by ureteral catheterization having failed in our hands, for technical reasons, the life of the moribund patient was saved by unilateral ureteropyelostomy. The restoration of isolateral renal function was immediate. When anuria occurs during sulfonamide therapy and conservative noninstrumental and instrumental treatment is fruitless within forty-eight hours, surgical drainage of at least one kidney should be instituted without delay. This offers the remaining hope for saving the patient's life, for, with the return to unilateral renal function uremia disappears, and at a suitable subsequent time—preferably within seven to ten days—cystoscopic efforts to unblock the opposite upper urinary channels can be made. If the unilateral operation fails to promote free urinary drainage within twelve to twenty-four hours, promptly and surgically drain the opposite kidney.

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TECHNIC FOR THE REPAIR OF "BASEBALL" FINGER

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IN repairing "baseball" finger of the type in which the bony attachment of the extensor digitorum communis ten-

during the healing period. On the other hand, the proximity of the nail-bed which is vulnerable to slight trauma, a terminal

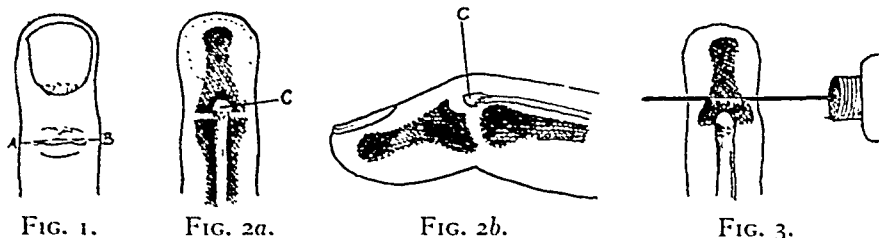FIG. 1.   FIG. 2a.   FIG. 2b.   FIG. 3.

FIG. 1. A-B shows line of incision.
FIG. 2A. C shows avulsed fragment to be freed (anteroposterior view). B same as A (lateral view).
FIG. 3. Needle transfixing base of terminal phalanx, passing through skin and subcutaneous tissue.

FIG. 4.   FIG. 5.   FIG. 6.
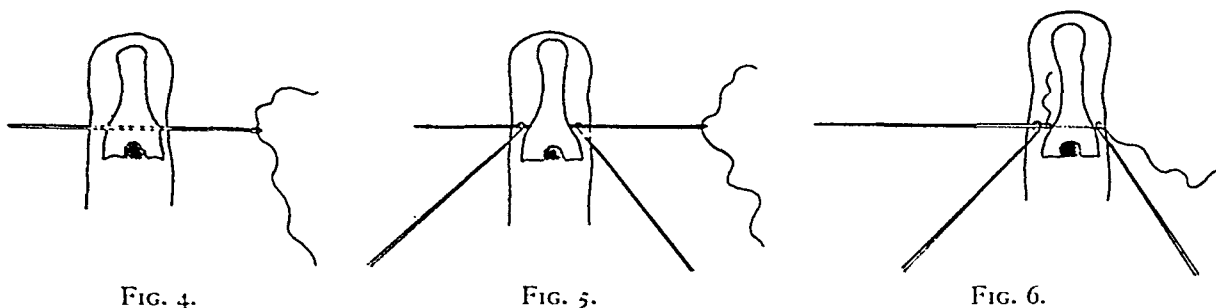
FIG. 4. Needle threaded after drill has been disconnected.
FIG. 5. Needle engaged by hooks which have been passed through transverse incision.
FIG. 6. Thread caught and pulled into wound with hooks, first one then the other, as needle is drawn through by assistant.
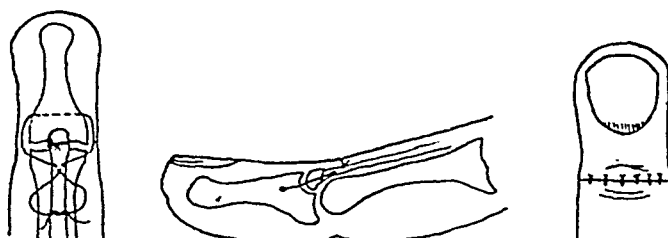
FIG. 7A.   FIG. 7B.   FIG. 8.
FIG. 7A. Tendon sutured close to bony fragment (antero-posterior view;) B (lateral view).
FIG. 8. Wound closed.

don is avulsed, there are several factors which predispose to poor end results. A satisfactorily functioning finger is dependent upon bony union and avoidance of scar tissue which would limit joint motion. The incision must be adequate to freshen and reduce the bone fragment, and the fragments must be held completely immobile

blood supply, and inelasticity of the skin making it susceptible to necrosis, limit the size of the incision and the amount of dissection. To meet these conditions the following technic has been developed:

A transverse incision is made on the dorsum of the finger corresponding to the prominent distal interphalangeal crease

and the flaps dissected in order to expose the extensor tendon with its attachment to fractured bone fragment. The fragment is
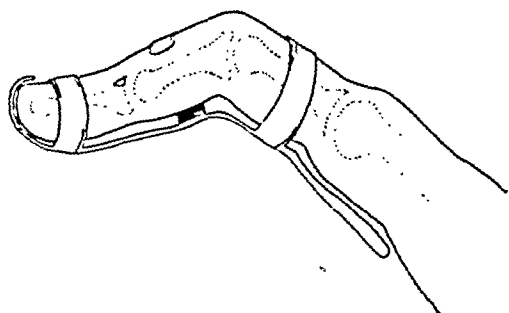
FIG. 9. Position of finger immobilized with malleable splint.

freed from surrounding adherent tissue and its fracture surface freshened, as well as the surface of the base of the distal phalanx into which it inserts. An ordinary darning needle, the diameter of a Keith needle, guided by a Kirschner drill, is then used to transfix the base of the distal phalanx. The insertion is made through the skin, subcutaneous tissue and bone without additional incisions. The drill is detached and the needle threaded with the nonabsorbable suture, cotton or silk to be employed. Through the wound, a hook resembling a dural hook, but firmer, is passed distally on either side of the terminal phalanx beneath the periosteum, hugging the bone until the needle is engaged. Then as the assistant slowly draws the needle through, the suture material is caught and brought down so that the free ends emerge at the incision site. Sutures are then taken in the extensor tendon close to the fragment and the ends tied, with the finger in hyperextension and the bone fragment fitting snugly into its slot. The wound is closed and the finger is splinted with the terminal phalanx in extension, and the proximal interphalangeal and metacarpophalangeal joints in the position of flexion corresponding to optimal function. For this purpose a well fitting malleable splint is satisfactory. A blood pressure cuff kept between 220 and 280 mm. of mercury is used as a tourniquet on the arm, and sodium pentothal intravenously is given for anesthesia. For draping after the hand has been prepared, a sterile cotton glove with finger to be operated upon cut out, is useful. Immobilization is maintained for three to four weeks, following which controlled passive and active motion are instituted. The steps in the operation are illustrated in the accompanying diagrams.

SUMMARY

The technic of performing this operation is, to my knowledge, new. It has been used in several cases with satisfactory results, assuring one of normal functioning joints, smoothly gliding tendon and bony union, as well as eliminating the less serious complications of nail-bed damage and sloughing wounds. Through simply a transverse incision it has been possible to obtain sufficient exposure, yet with a minimum of dissection. It has the additional advantage of being applicable to the repair of digital flexor and extensor tendons shorn at their insertions, when no soft tissue remains for suture. By freshening the site of bony attachment and making a trap-door for insertion, the tendon may be sutured and held in place, using this technic.

SKIN GRAFTING*

A NEW METHOD BASED ON THE PRINCIPLES OF TISSUE CULTURE

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WHILE skin grafting has progressed technically a long way in the past decade or more, the fact still remains that the usual methods have not always proved satisfactory. This is especially true in areas where normal physiologic movements, such as respiratory activity of the chest wall, interfere with the "take" of a graft. Similarly, irregular, uneven, angulated regions like the nose or ear occasion particular difficulties in obtaining successful end results, because of the necessity of stitching the graft, and of using pressure dressings which interfere with the blood supply all too frequently.

As a result of my experience in assisting at an operation for skin grafting in which considerable difficulty was encountered because of bleeding caused by stitching the graft, I began to wonder whether the same principles which were successful in growing cells outside the body in tissue culture might not be applicable to skin grafting by providing physiologically, adhesion of the graft to its bed through the use of plasma. In tissue culture growth is obtained by supplying (1) a suitable surface for the cells to grow on through the use of coagulated plasma, and (2) adequate nutrition through a medium made up of embryonic tissue extract and a buffered salt solution (Tyrode's solution).[1] The most satisfactory cell growth is obtained in tissue culture by the use of homologous plasma and tissue extract. The plasma is heparinized when obtained to prevent its coagulation until it comes into contact with the tissue extract and salt mixture at the time of planting the culture. With such contact the fibrin is precipitated and a delicate clot formed which serves to fix the tiny fragment of

tissue, and thus permits cell growth to take place. In such cultures, it has been shown repeatedly that fibroblastic proliferation normally begins within a matter of a few hours.

Based on the principles just outlined, experimental grafts were made on a series of twelve rats, with most gratifying results. The technic employed in this study is outlined in the following paragraphs. To create the most favorable conditions the plasma and cell extracts used in this work were not only homologous, but actually autogenous in each instance. Further studies are in progress to determine whether such refinements of technic are necessary. As will be apparent from the discussion, in any actual clinical case it is just about as practical a procedure to use the patient's own plasma and cell extract as a stock preparation.

PROCEDURE

Blood is taken from the rat's heart and mixed in the proportion of 1 mg. of heparin to each 5 cc. of blood. This is then centrifuged, the plasma pipetted off and kept in the refrigerator until needed. Tyrode's buffered salt solution is added to the packed red and white cells volumetrically, in the proportion of 5 parts Tyrode's solution to 1 part red cells. This mixture is shaken vigorously and allowed to stand at room temperature for one half hour. It is then centrifuged and the supernatant fluid removed. This supernatant fluid will be referred to subsequently as "extract."

The rat is shaved over the site elected for the experimental graft. Areas over the chest wall and the nape of the neck were chosen as representing the sites least likely to succeed because of the movements of the

chest wall and animal's head. The skin in these areas is removed and a sterile dressing applied to prevent infection from developing. At the end of four days healthy granulation tissue has formed at the base of the denuded areas and the animals are considered ready for actual grafting procedure.

Skin grafts of full thickness are removed from the abdomen or sides of the animals under the usual aseptic precautions. Excessive fat is carefully removed from the undersurface of the graft, which is then trimmed to fit the denuded area or to cover its central part. The graft site is then painted with a drop or two of the heparinized plasma by means of a sterile fine camel's hair brush. Similarly, the under surface of the graft is painted with "extract." The graft is then placed on the denuded skin area and carefully fitted by means of forceps.

To produce fixation of the grafts through coagulation of the thin layer of plasma, hot compresses (at about 50°C.) are applied, using gentle pressure. These compresses are renewed frequently and maintained for between five and ten minutes. No dressings except one thickness of vaseline gauze to protect the tissue from infection are used. Stitches are not necessary whether the graft is a few millimeters or a few centimeters in size. A cork ring is placed over the gauze to protect the operative field from trauma and this is held in place by adhesive tape. At the end of twenty-four hours the site of the graft is inspected and any serum which has accumulated around the edges gently wiped off, and the protective covering reapplied for from forty-eight hours to seven days depending upon the size and the location of the graft. Within forty-eight hours the graft has become vascularized and assumes a normal, healthy color. Care is necessary in such animal experimentation to prevent too great pressure in the application of the ring, thus impeding venous circulation and causing edema.

When the technic is properly carried out the procedure has resulted in 100 per cent takes. Obviously, minor modifications of the method may be introduced depending upon many factors. If the graft is small enough or in a site little subject to trauma, plasma alone is quite satisfactory, although the use of the "extract" appears to give somewhat better fixation of the graft. The graft does not adhere so well if first bathed in saline and this procedure, so frequently used in skin grafting, is entirely dispensed with. After the graft is fixed its immobility is always tested by producing gentle traction on it with forceps. It is invariably quite adherent, but where no plasma or hot compresses are used it slides under the slightest traction.

As a result of the success of these initial animal experiments and with the co-operation of the members of the surgical staff of Temple University Hospital, the method is being utilized successfully in clinical cases. These will be reported at a later date. Because of the tremendous number of casualties in this present global conflict which will require skin grafting as a result of their injuries, it was believed that this new method should be made available to the medical profession as promptly as possible.

SUMMARY

A new method for skin grafting is presented, depending upon the principles of tissue culture, namely, the fixation of the graft by means of a thin coagulum of autogenous plasma. No stitches or pressure dressings are necessary.

Besides the clinical work, further experimental animal work is in progress to simplify the method and broaden its application.

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Case Reports

REIDEL'S THYROIDITIS

REPORT OF TWO CASES

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THE purpose of this communication is to emphasize the importance of the careful consideration of thyroid disease (Reidel's Struma) in patients who appear neurotic, bordering on a psychoses, and who in spite of rational medical therapy over a period of time become progressively worse. Of 800 cases of hyperthyroidism studied by Foss and Jackson mental disorders were found in two cases. Parker found that less than 2 per cent of patients with exophthalmic goiter presented mental derangements. In view of the infrequent association of these two conditions and the presence of the neurosis, or even symptoms simulating psychoses, in the two cases of chronic thyroiditis seen within a short period of time, it was thought interesting enough to make this report. The diagnosis became apparent only after careful daily observation.

CASE REPORTS

CASE I. B. D. age thirty-seven, a white female secretary, complained of extreme nervousness with attacks of hysteria, choking sensation and slight cough, pain and swelling of thyroid since February 27, 1942, and light temperature.

In her past history she had had her tonsils and adenoids removed in 1922, appendectomy and resection of ovary in 1926 and cholecystectomy in 1929. A fistula of the rectum was operated upon in 1929 and an operation for osteomyelitis of the left femur was performed in 1933. She has had repeated attacks of sore throats and sinusitis in the past year.

For the past two years she complained of ill health almost continuously. She felt nervous, irritable and would become hysterical without apparent reason. She complained of palpitation and inability to gain weight in spite of complete rest, a high caloric diet and the administration of tonics.

At no time did she notice any swelling in her neck until February 27, 1942 at which time examination revealed a tender mass in the right lobe of the thyroid. The appearance of the swelling was accompanied by cough and choking sensation with persistence of local pain which later radiated to the right ear and right side of the neck. The temperature would range from 99° to 100.5°F. and the swelling and tenderness extended across the isthmus to the left lobe within a period of one week. She also had profuse sweats, attacks of tachycardia and began to lose weight. She was kept under observation for one month during which time the swelling and tenderness would migrate from one lobe to the other.

The patient appeared to be somewhat emaciated and looked chronically ill. While the eyes did not reveal exopthalmus there was present a definite stare with markedly dilated pupils. Examination of the neck revealed a uniform enlargement of both lobes of the thyroid and isthmus. The right lobe was slightly larger than the left one. Tenderness of the gland was present at all times, however, during the period of observation in the hospital as the tenderness disappeared the gland became quite hard and firm and just before operation the entire gland was stony hard. There were no other palpable glands in the neck. The mucous membranes of the nose and throat were red and congested.

The lungs and heart were normal. The patient's blood pressure was 90/170. The abdomen showed nothing abnormal. On Feb-

be very hard in consistency, intimately adherent to surrounding tissue. The right lobe was moderately enlarged. The isthmus was quite
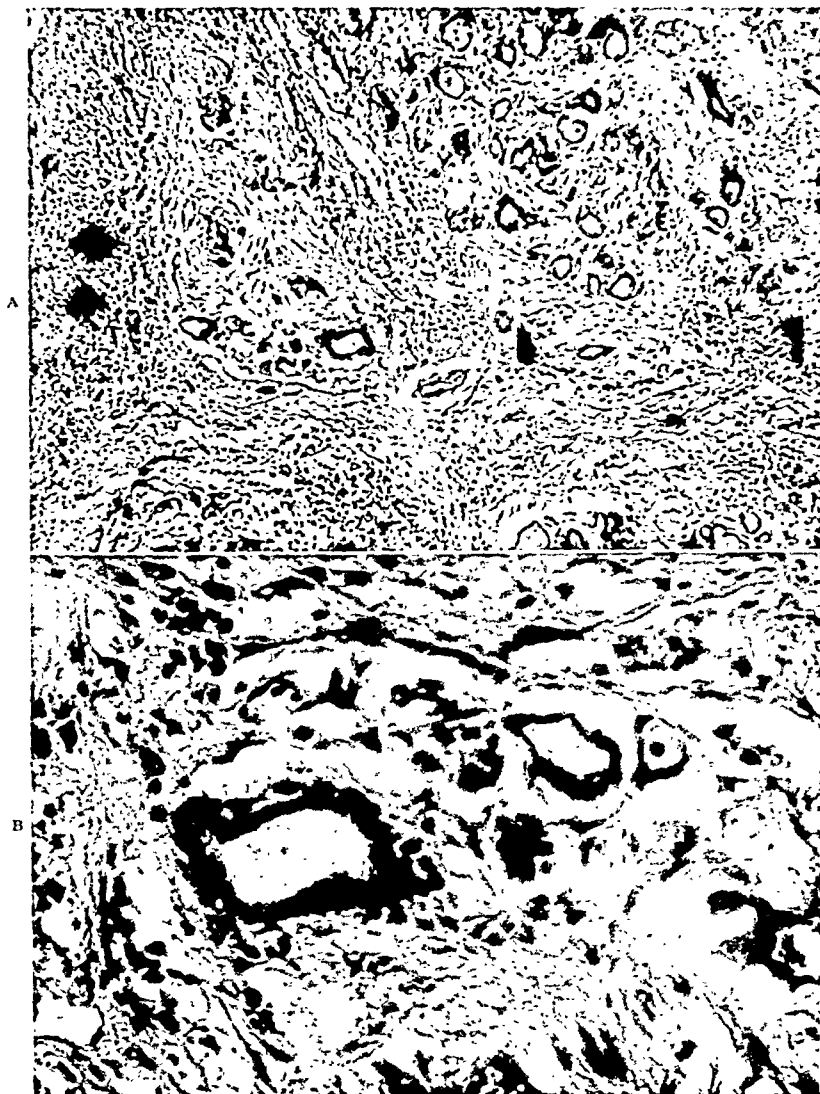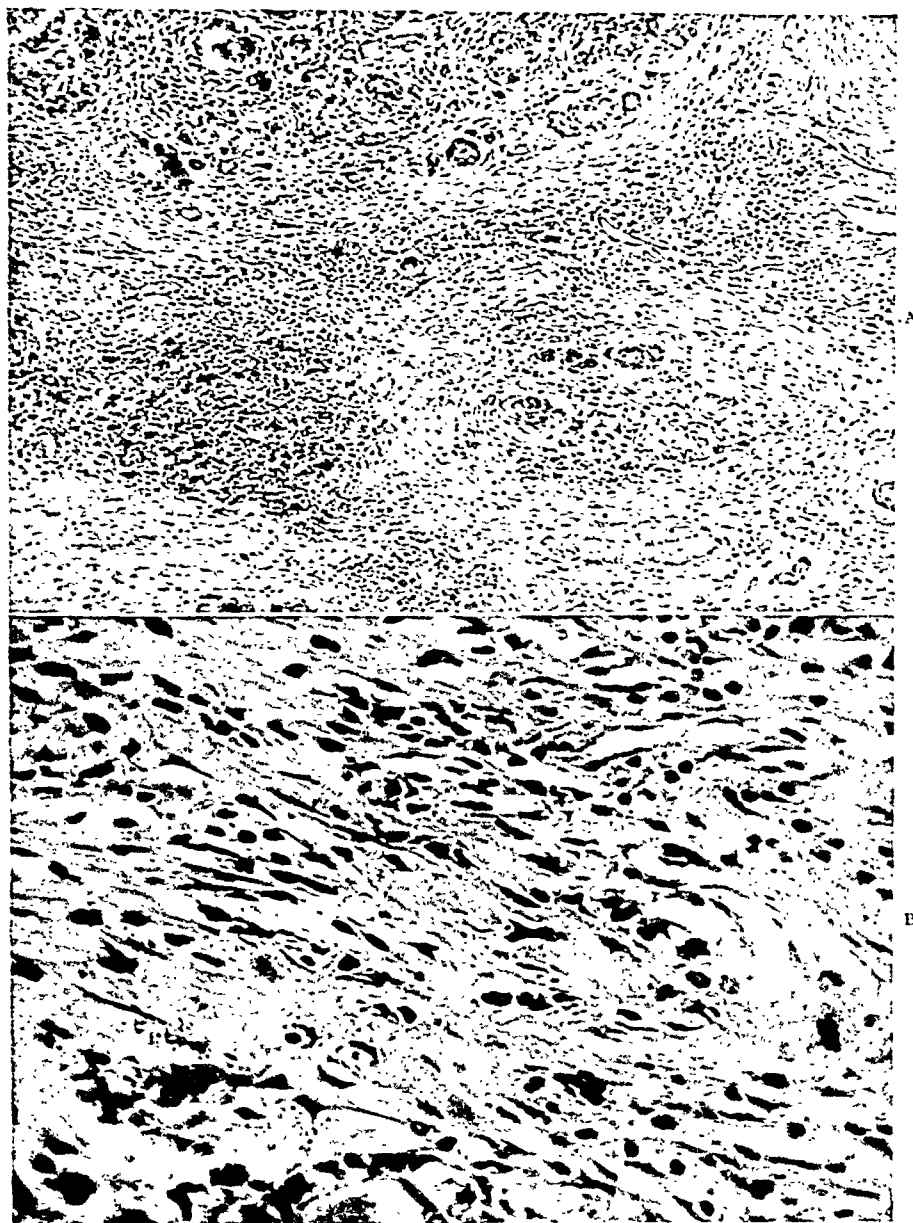

FIG. 1. Case 1. Low and high microscopic studies of slides of thyroid gland. Low power magnified 100 times and the high power 400 times.

ruary 28th the basal metabolic rate was plus 1, on March 13th it was plus 38 and on March 24th it was plus 20. There were 3,750,000 red blood cells, 86 per cent hemoglobin, 7,750 white blood cells, 57 polymorphonuclears, 33 lymphocytes, sugar 89 and cholesterol 150.

The patient was admitted to St. Vincent's Hospital on March 12, 1942. Lugol's solution and sedation were continued. The general condition improved and she was operated upon April 2, 1942, under cyclopropane anesthesia.

Upon exposing the thyroid it was found to

enlarged and the left lobe was about three times normal size. The left lobe was actually stony hard in consistency. One small adenoma could be felt in the right lobe.

A low collar incision was made, the thyroid was exposed and a subtotal resection of both lobes was done. The isthmus and medial portions of both lobes were very adherent to the trachea. Gland tissue was grayish in color and cut like cartilage. Bleeding points were all controlled and resection was done after division of the isthmus, leaving the posterior portion

of both lobes intact. A drain was placed over both resected lobes and the neck was closed in layers. Sulfanilamide was applied into the wound.

gray, homogeneous appearance. One of the pieces contained a cyst measuring 6 mm. in diameter.

There was a considerable increase in connec-

FIG. 2. Case 11. Low and high microscopic studies of slides of thyroid gland. Low power magnified 100 times and the high power 400 times.

The postoperative course was uneventful. The wound healed by primary union and the patient was completely relieved of her symptoms when she left the hospital on her twelfth postoperative day. To date, October 15, 1942, she has gained 15 pounds in weight and has no complaints.

The pathological report by Dr. A. Rottino revealed the following: The specimen consisted of four pieces of firm thyroid tissue of varying sizes all together weighing 20 Gm. On section the cut surface presented a smooth,

tive tissue between the alveoli. In the interstitial tissue one also noted considerable lymphocytic infiltration. In some portions of the gland there was almost complete replacement of alveoli by inflammatory tissue. In an occasional area, tubercle-like lesions were seen composed of giant cells, centrally placed, surrounded by epitheloid cells. In other areas one found granulomatous lesions in which polymorphonuclear leucocytes were found surrounded by larger epitheloid-like cells.

In thyroid glands exhibiting chronic inflammation one at times finds a pseudotuberculous picture. The demonstration of tubercle bacilli is usually impossible. This lesion probably was in the nature of a foreign body reaction, the foreign body being the products of disintegration of colloid.

CASE II. E. B., age 50, a white female housewife, complained of a mass in her neck, nervousness, a loss of 20 pounds in five weeks, weakness, cough, and an intermittent temperature for five weeks. The family history was negative.

For the past year the patient complained of repeated sore throats, painful swelling of neck and increasing nervousness. Two weeks previous to admission to the hospital she developed progressive mental confusion, incoherence in speech and flight of ideas. For five weeks before hospitalization she felt she had temperature at some time during the day. The swelling of the neck became quite apparent about one year ago. The size of the swelling would vary and as time went by she noticed an increase in size and tenderness of the mass (thyroid).

The patient appeared emaciated, almost cachectic. There was a nodular enlargement of both lobes and the isthmus of the thyroid. The gland was about four times the size of the normal gland. The right lobe was larger than the left. The tumor was stony hard and appeared to be adherent at several points to the surrounding tissue. It was tender on palpation. No nodes were palpable. The preoperative diagnosis was either malignancy of the thyroid or chronic thyroiditis. The lungs were normal. An electrocardiogram revealed myocardial damage. Blood pressure was 170/90, and the basal metabolic rate plus 19. The blood picture essentially negative.

On September 1, 1942, the patient was operated upon under cyclopropane anesthesia. Upon opening the neck the thyroid was found to be enlarged to about three times its normal size, the right lobe being somewhat larger than the left. The right lobe contained numerous nodules simulating adenomas. The consistency of the entire gland was stony hard in character. There was also present a considerable amount of fibrinous exudate over the entire gland and numerous old and recent adhesions made the gland adherent to surrounding tissue, including the trachea. The condition was one typical of chronic thyroiditis. Carcinoma had to be excluded.

A transverse incision was made overlying the thyroid. Ribbon muscles were cut and the thyroid gland exposed. There was remarkably little bleeding and a subtotal thyroidectomy was performed. The wound was drained and closed in layers, using chromic gut for muscle and dermal for the skin. Sulphanilamide was applied in the wound.

The postoperative diagnosis was chronic thyroiditis (Riedel's).

The pathological report by Dr. A. Rottino was the following: The specimen consisted of two lobes of thyroid gland weighing 40 Gm. One of the lobes measured 5 by $3\frac{1}{2}$ by $1\frac{1}{2}$ cm. Its surface was covered with a thin transparent capsule. On section the gland presented a peculiar homogeneous, pale surface with small areas of glairy, brown colored patches scattered about. The second lobe was smaller measuring 3 by $3\frac{1}{2}$ by 1 cm. Its capsule was somewhat shaggy. On section it presented the same pale homogeneous surface with nodules brown in color, measuring as much as $\frac{1}{2}$ cm. in diameter.

On section the thyroid gland was found very much altered by a chronic inflammatory process. There was a marked increase in fibrous tissue throughout. There was also diffuse dense infiltration with lymphocytes. The thyroid lobules appeared as irregular nodules of varying sizes surrounded by a thick fibrous wall and composed of acini, small in size and lined by cuboidal epithelium and filled with densely staining colloid.

The postoperative course was uneventful and the wound healed by primary union. The patient was discharged after ten days with complete relief of symptoms. To date, October 15, 1942, she has gained 8 pounds and has no complaints. *Diagnosis:* chronic thyroiditis.

REMARKS

As stated previously the association of extreme neurosis or phychosis with most thyroid diseases is not frequent. I believe that in the cases herein reported the mental reactions were probably of the toxic exhaustion type. Toxic exhaustive psychoses have been found usually in cases of thyrotoxicosis due to either exophthalmic or adenomatous goiter, however, the history has usually been short and rapid improvement followed medical treatment. In the two cases herein reported medical treatment did not help. Although the

toxicosis is of thyroid origin in the exophthalmic, adenomatous, and in the cases with thyroditis, in the latter, there is probably the production of an active toxin while in the other two conditions it may simply be a thyroid disfunction.

The etiology of this condition is not definite. Focal infection has been considered a possible cause and in both the cases reported there have been definite foci of infection in the upper respiratory tract, sinusitis and throat infection in one and repeated sore throats in the other. Plummer has considered tuberculosis as a possible cause and Meeker has mentioned the possibility of a relationship between remnants of the postbronchial body and Reidel's Struma.

In making the diagnosis of Reidel's disease I believe the history is very important. Both patients complained of nervous manifestation over a period of time with some cough and choking sensation. The condition would become improved temporarily without medication; however, as the process progressed the nervous manifestation would become aggravated to the point where the patients appeared to be in a continuous state of hysteria. There was progressive loss of weight in both cases and at the time of operation they appeared to be chronically ill. The basal metabolic rate in both cases was somewhat elevated. Locally of course there is the enlargement of the thyroid, stony hard in character, with or without tenderness all depending upon the activity of the process at the time of examination. At one time the right lobe in Cases 1 was so extremely tender I thought the patient might be developing a localized abscess in the gland. This, of course, was an acute exacerbation of the chronic process.

In making a differential diagnosis, one has to consider principally toxic adenomas, malignancy of the thyroid and Hashimoto's disease, and other conditions to be considered are infectious thyroiditis, tuberculosis, syphilis and phlegmon of thyroid.

In malignancy of the thyroid, the patient is usually over forty-five years of age and gives a history of pre-existing adenoma of the thyroid. The skin and cervical glands are usually involved in malignancy and not with Reidel's thyroiditis. Pain is more pronounced with malignancy.

In toxic adenoma one has the marked elevation of the metabolic rate and the symptoms that go with it. Locally, there is usually the circumscribed tumor mass which is not stony hard in consistency and not tender to palpation.

In Hashimoto's disease, there is a tendency to myxedema with a uniform enlargement of the gland which is not stony hard on palpation. Hashimoto's disease responds to radium while Reidel's disease does not as a rule.

The treatment of Reidel's Struma is primarily surgical. Relief of both local and constitutional symptoms are obtained immediately after operation.

SUMMARY

1. Two cases of Reidel's Struma are herein reported.

2. In both cases nervous manifestations were very marked, and when present with thyroid enlargement of stony hardness one should consider Reidel's Struma.

3. Surgery afforded immediate relief in both cases.

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BILATERAL RUPTURE OF QUADRICEPS FEMORIS TENDONS WITH SIX-YEAR INTERVAL BETWEEN INJURIES

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COMPLETE rupture of the quadriceps femoris tendon is a relatively rare traumatic lesion. Conway,[1] in 1940, reported only five cases in five years in an active metropolitan hospital (St. Vincent's). Carlucci,[2] in 1934, found only four cases at Bellevue in the preceding ten years; during the same time there were 318 fractures of the patella in the same hospital. Sonnenshine[3] reported four cases of ruptured quadriceps tendon to fifty-one cases of fractured patella in five years at the Harlem Hospital. Meyerding,[4] in 1935, reported nine cases in ten years at the Mayo Clinic.

Bilateral rupture of the quadriceps tendons are even more rare. Cases have been reported by Meyerding,[5] Frey,[6] Sonnenshine,[3] Milne,[7] Chichester,[8] Woodbridge,[9] Kelly[10] and James.[11] In all of these cases the second rupture occurred either when the patient attempted to rise after the first injury or within the course of a few days. In the case herewith reported there was a period of six years between the two ruptures. The first rupture in this case was not repaired and the second was, so that an interesting comparison between an old unrepaired rupture and a recent repaired one is presented in the same patient.

Extension of the leg at the knee is produced by the action of the quadriceps muscle. The quadriceps muscle is composed of the rectus femoris and the three vasti muscles, the vastus medialis, the vastus lateralis and the vastus intermedius. The tendons of these muscles converge into a common tendon, the quadriceps tendon. This common tendon is inserted into the tibial tubercle and contains the patella as a sesamoid bone. The portion of the tendon inserted into the proximal or superior margin of the patella is known as the quadriceps tendon, and the portion extending from the distal or lower margin of the patella and anchoring it to the tibial tubercle is known as the patellar ligament or patellar tendon.

Complete rupture of the quadriceps tendon produces a prompt and marked disability, as active extension of the leg at the knee is immediately lost. This results in inability to walk, and medical attention is usually sought at once.

If the patient is seen shortly after the injury, the diagnosis should not be missed. The nature of the accident will give a clue to the injury, the same type of accident that causes a fracture of the patella being the usual one, that is, a sudden violent contraction of the quadriceps muscle while the knee joint is hyperflexed. This usually occurs in a misstep or a sudden attempt to regain one's balance. Very rarely rupture of the quadriceps may occur from a direct blow.

Pain, inability actively to extend the leg, and a sulcus above the patella, where the tendon has separated and retracted are immediate cardinal signs of this injury. In a complete tear, the condyles of the femur can be readily felt and a normal easily movable patella can usually be palpated. Later these signs may be obscured by the hemarthrosis and swelling, which occurs in the course of a few hours. Tenderness in the region of the injury will be a constant finding. X-rays should be taken to rule out fracture of patella or other fractures about the knee joint.

Etiology. Factors which may cause a tear or rupture of muscle or tendon as listed by Gilcreest[12] are: (1) Senility; (2) patho-

logical changes, such as, arthritis, myositis, acute infectious disease, arteriosclerosis, syphilis, tuberculosis, neoplasm; (3) physi-

rupture that some intrinsic weakness in the tendon or its attachment was one of the most important factors.

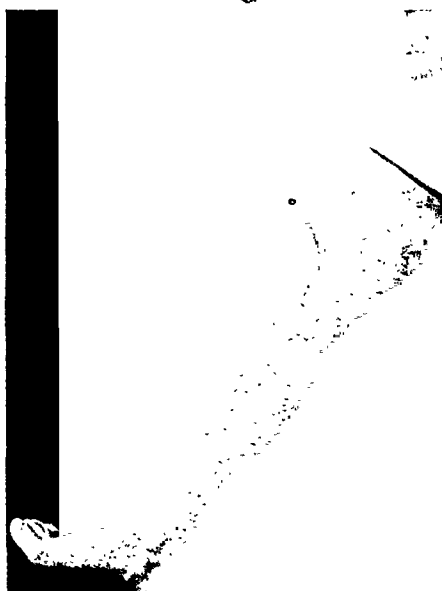

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. Shows scar three months after repair on right knee, and shows on left knee how fingers can be introduced behind patella through old rupture of quadriceps.

Fig. 2. Lateral view, showing how fingers can be introduced behind patella through old tear of quadriceps.

Fig. 3. Showing degree of extension of repaired quadriceps tendon three months after operation.

Fig. 4. Showing degree of flexion three months after repair of quadriceps.

ologic predisposition; (4) occupation; (5) fatigue, and (6) trauma which is either direct or indirect.

It would seem from cases of bilateral

The incidence of quadriceps rupture is greatest in the age group of fifty to seventy years, and is somewhat more common in males.

FIG. 5. Showing lack of complete extension following unrepaired rupture of quadriceps tendon and depression above patella.

FIG. 6. X-ray, anteroposterior view of right knee joint; recent rupture of quadriceps tendon.

FIG. 7. X-ray, lateral view of right knee joint with recent rupture of quadriceps tendon, showing intact patella.

The treatment of complete rupture of the quadriceps tendon is by surgical suture of the tendon. The incision technic and

in an ambulance and on admission x-rays were taken, which showed no bony injury. The admission diagnosis was dislocation of left

FIG. 8. X-ray, anteroposterior view of left knee joint: old rupture of quadriceps tendon.

FIG. 9. X-ray, lateral view of left knee joint; old rupture of quadriceps tendon; patella slightly lower than on right.

type of suture material used vary considerably, but the principle of prompt suture of the torn tendon and its lateral expansions, with splinting in the extended position is common to all. This case illustrated well the necessity for open operation.

CASE REPORT

The patient, C. G., a white female of forty-six, who was working as a housekeeper, caught her left heel in a torn hem in her skirt, falling heavily and severely injuring her left knee. There was deformity of the knee, extension was immediately lost, and the patient stated that the knee cap was displaced downward. The attending physician made a diagnosis of dislocation of the knee joint and reduced the dislocation. She was removed to the hospital

knee and rupture of quadriceps tendon. The knee was not dislocated on admission to the hospital. The patient refused operative repair of the injury, and the leg was placed in a posterior splint and the patient put to bed. On June 15, 1936, six weeks after the injury, the splint was removed, and the patient was allowed out of bed. During the next two weeks she got about on crutches, and on June 30, 1936, she was discharged from the hospital walking with a cane. The result was what would be expected without the repair of the torn tendon. There was loss of about forty degrees of extension, a large defect above the patella, and considerable limping. It was as a result of this, that the injury to her right knee occurred.

On July 14, 1942, the same patient, now aged fifty-two, while walking on the street came to an uneven spot on the sidewalk where

she caught the heel of her left foot, which was the side with the previously injured knee. To keep from falling, she forcibly extended the right knee, felt a sudden pain and fell to the sidewalk. She was unable to rise and was carried to her home, where I saw her within a half hour of the injury. The diagnosis was very apparent particularly in view of the old injury to the left knee. There was not yet much swelling of the right knee, and a large gap was present above the patella, which was unusually mobile. The back of the patella and the anterior part of the knee joint were easily palpated. Needless to say, loss of extension of the right leg was practically complete. The patient was removed to the hospital and the leg was placed in a posterior splint. The following morning x-rays were taken, which revealed no bony injury or abnormalities. She agreed to open repair of the recent injury, but refused repair of the old injury. After waiting a week to allow swelling to subside, and tissue resistance in the knee joint to develop, the patient was operated upon on July 21, 1942.

Under ether anesthesia, the skin was prepared with merthiolate, draped and the knee joint and patella exposed by a horseshoe shaped incision above the patella, with the convexity upward. The quadriceps tendon was found completely torn off from the upper border of the patella with deep tears into the lateral expansions of the tendon. The knee joint was filled with blood clots which were evacuated. The tendon was sutured to the remaining tendon on the anterior surface of the patella with kangaroo' tendon. The fascia was sewn with chromic catgut. Four Gm. of sulfathiazole powder were placed in the joint and 4 Gm. in the incision. The skin was closed with plain catgut, the wound dressed, and a circular plaster cast applied.

The postoperative course was smooth, the patient being allowed up in a chair on the eighth postoperative day. On the thirteenth postoperative day, the cast was split and the dressing changed. The wound had healed by first intention. The patient walked about a little with the leg in a cast and used a cane until about five weeks after the operation, when the cast was removed and an elastic bandage applied. She was then able to get about with the use of a cane, and has improved steadily since, until the present time, three months postoperatively. The function in the leg is about normal.

SUMMARY

Total rupture of the quadriceps tendon is a relatively uncommon condition. This patient presents an interesting comparison between an unrepaired rupture of the left quadriceps suffered six years ago, and a repaired rupture of the right quadriceps, sustained three months ago. No attempt has been made to go into the etiological factors of the condition, but it is believed that this case illustrated in one patient the importance of early surgical repair of the torn quadriceps tendon.

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CHRONIC ILEITIS WITH CONCOMITANT URETERITIS*

CASE REPORT

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A CAREFUL search reveals that while over a thousand cases of regional, nonspecific enteritis have been reported from all over the world, no cases of urologic complications have been previously cited. In the decade since the disease was described by Crohn and his co-workers, no definite etiological agent has been found. According to present knowledge from a study of the diseased tissues, the underlying disturbance is an infectious process that gives rise to a nonspecific, granulomatous reaction. The area affected is usually the terminal ileum but other parts of the ileum and jejunum have been described as being similarly involved. As the disease progresses, there is a characteristic formation of fecal fistulas. These are caused by a lytic change induced by inflammatory processes and the fistulas most frequently seen are peri-anal, perirectal, rectovaginal, or burrowing into a previous laparotomy scar. It is of interest to urologists to note that no fistulas have been reported draining into the lumbar area. Another characteristic change is the formation of large, inflamed glands draining the infected area. It is possible that in this case report about to be presented of a concomitant ureteritis with a regional ileitis, the infecting agent spread to the ureter via the lymphatics of the lower ureter which drain into the hypogastric plexus and from there an anastomosis with the inferior mesenteric glands is possible. The infrequency of ureteral complications with ileitis suggests the fact that this lymphatic anastomosis between the intestines and the ureter is either a rarity,

or attention has not been sufficiently focused on the urinary tract as a possible source of concomitant disease.

Another point of interest in this disease entity is that the pathologic picture may go on to regression. Probstein and Owenfeld have reported a biopsy in which during the closure of an enterostomy wound three months after an acute onset of nonspecific ileitis, normal tissue was found. In this case, also, the disease changes in the ureter regressed after the intestines were successfully treated.

CASE REPORT

A sixteen-year old male was admitted to the New York Post-Graduate Hospital for the first time on November 26, 1939, with a chief complaint of frequency and nocturia of eighteen months' duration. In addition to having to get up three times at night to void, the patient also had frequently wet the bed. Further questioning elicited a history of intermittent gastrointestinal disturbances over a period of six years consisting of epigastric pain and borborygmus. The past history of this patient was negative except for an abdominal injury in 1935 sustained while playing football.

Physical examination was negative except for a moderate tenderness over the right kidney and bladder region. A medical consultation suggested a diagnosis of appendiceal abscess, adherent to the ureter with resultant infection of the urinary tract.

An intravenous urogram taken shortly after admission (Fig. 1) revealed dilatation of the right renal pelvis and calyces as well as blunting of those of the upper pole. Angulation and constriction at the ureteral pelvic junction, dilatation of the ureter and a diverticular-like

pouching on the left side of the urinary bladder was also noted.

Cystoscopy and retrograde pyelography

Fig. 1. Intravenous urogram showing dilatation of right renal pelvis and calyces with blunting of those of upper pole; also angulation and constriction at ureteral pelvic junction, dilatation of the ureter, and diverticular-like pouching on the left side of urinary bladder.

(Fig. 2) revealed marked congestion about the right ureteral orifice. There was a definite right pyelectasis with narrowing of the lower end of the ureter, suggestive of stricture due to an extrinsic or intrinsic factor. However, the condition was not deemed sufficient to explain the clinical picture. The possibility of subacute appendicitis was entertained.

Laboratory analysis of the urine was essentially negative save for 20 to 30 leucocytes per high power field. The blood count showed 3,350,000 red blood cells, 56 per cent hemoglobin, 6,800 white blood cells with a differential of 59 per cent polymorphonuclear and 1 per cent eosinophiles, and 6 per cent mononuclear, 34 per cent lumphocytes. Blood chemistry was within normal limits. The urine culture showed Bacilli coli acidi lactici and nonhemolytic streptococci. The right kidney urine was negative.

On the fourth hospital day, the patient had a sudden rise in temperature which quickly sub-

sided, only to rise again four days later. On his eleventh hospital day, a barium colon enema was done. An inflammatory infiltrated lesion

Fig. 2. Retrograde pyelogram showing right pyelectasis with narrowing of lower end of ureter suggestive of stricture due to extraneous mass.

with typhilitis and mass in the right iliac fossa was suggested. In view of the general colonic atonicity alternating with spasms of the distal colon, the likelihood of concomitant colitis or dysenteric infection was entertained. A chest plate was negative. Surgical consultants believed that the right lower quadrant mass was probably granulomatous. The white cell count at this time was 16,400 with 82 per cent polymorphonuclears, 4 per cent mononuclears and 14 per cent lymphocytes. Urinalysis showed consistent pus. The blood Wassermann test was negative.

The patient was operated upon by Dr. Ralph R. Moolten of the Surgical staff on his eleventh hospital day and he was found to have regional ileitis. The terminal ileum and cecum were involved in an inflammatory reaction. The ileum proximal to the ileitis was anastomosed to the transverse colon. Eight days later all drains and sutures were removed. The patient was discharged on his fifteenth postoperative day.

The boy was readmitted to the hospital on March 21, 1940. In the interim he reported

that he had felt fairly well with drainage from his ileotransverse colostomy. The discharge, however, had increased greatly in the past

An intravenous urogram (Fig. 3) taken on the day of his discharge showed a moderate ureteropelvic dilatation on the right side with

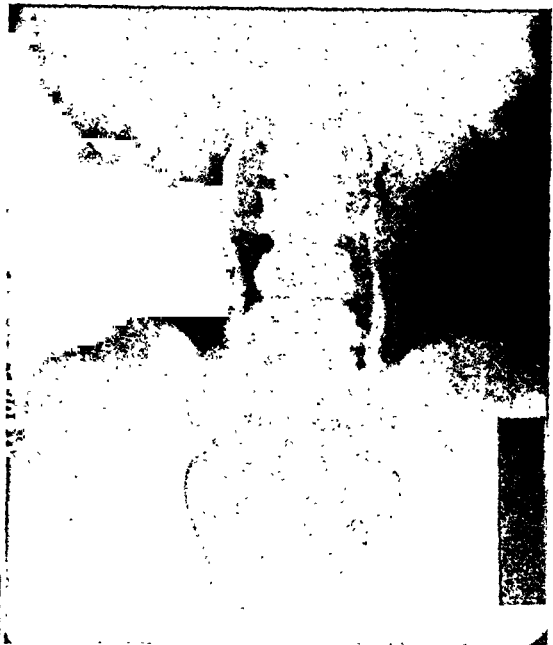Fig. 3. Four months after temporary ileo-transverse colostomy showing persistence of ureteral changes.

Fig. 4. Intravenous urogram six months after permanent resection showing normal right ureter after obstructing mass and inflammatory focus was removed.

three weeks, necessitating changing of dressings three times a day. However, he had had normal bowel movements during this time. On examination, the midabdominal scar was found to be well healed with keloid formation, but there was an open sinus at the lower portion. Surrounding the ostium there was a two inch area of induration. Greyish green purulent material oozed out of the opening.

Five days after the second admission, the patient had a resection of the lower ileum and ascending colon performed by Dr. Thomas Russell, the Director of Surgery at the New York Post-Graduate Hospital. The aforementioned sinus was dissected down to its base which was clamped and cut, and the base of the fistula closed. Adhesions between both the large and small intestines and the urinary bladder were separated. Removal of the terminal ileum, cecum, ascending colon, and transverse colon, proximal to the transverse colostomy was done. The portion of the ileum distal to the anastomosis was closed as was the transverse colon proximal to the anastomosis. The patient was discharged from the hospital on his thirty-fifth postoperative day in excellent condition with the wound well healed.

angulation at the ureteral pelvic junction as well as in the midabdominal ureter. Partial obstruction (apparently extrinsic) appeared to originate at about the level of the lower sacro-iliac margin. There was no evidence of lithiasis. Laboratory findings at this time were essentially as on previous admission.

About six months later, on October 24, 1940, the patient was readmitted to the hospital for the third time for an intravenous urogram. (Fig. 4.) The plates showed considerable improvement, with return of the right ureter and pelvis to normal size. Laboratory findings at this time were normal.

A recent examination in the "follow-up" Urological Clinic in December, 1942, showed this boy to be perfectly healthy and normal in every respect. He had obtained employment as an elevator operator and was performing entirely satisfactory service. He offered no complaints as to either the genitourinary or gastrointestinal tracts and had gained twenty-five pounds in weight and two inches in heigth. The boy has also passed a physical examination and been accepted for duty with the inactive reserve of the Army Air Corps.

CONCLUSION

1. A case is herewith presented of chronic regional, nonspecific ileitis with concomitant ureteritis. The mode of transmission of the infecting agent is unknown, but there is a possibility of lymphatic drainage from the inflammatory mass in the intestines to the ureter.

2. It was also demonstrated that there was definite extrinsic pressure on the ureter from the granular mass of the ileum.

3. As soon as the focus of infection and obstruction in the intestines were removed, the ureter returned to normal physiology and structure.

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THE three possible sources of gaseous distension of the obstructed gut are (1) formation of gas as a result of digestive processes, (2) diffusion of blood gases into the intestinal lumen, and (3) passage of swallowed atmospheric air into the intestine. The gases commonly present in intestinal meteorism are nitrogen, oxygen, carbon dioxide, hydrogen, methane, and hydrogen sulfide, the proportions being subject to considerable variation.

MALIGNANT CARCINOID OF THE STOMACH*

CASE REPORT OF A PATIENT TREATED BY SUBTOTAL GASTRECTOMY

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WE are presenting a case report of a malignant carcinoid of the stomach. The diagnosis was established histologically following a subtotal gastric resection. The clinical impression was that of gastric malignancy. Roentgen studies revealed a new growth in the pyloric region of the greater curvature. This finding was corroborated at the operating table. Here the diagnosis of gastric malignancy with regional glandular metastases was made.

A brief historical review of this subject attributes the first description of carcinoid tumors to Langhans in 1867. It was in 1888 that the true differentiation between carcinoid and ordinary adenocarcinoma was made by Lubarsch. The term, carcinoid, was used for the first time by Oberndorfer in 1907. The cytoplasm in the cells of carcinoid was shown by Gossel and Masson to have a selective affinity for silver salts. These cells were identified as argentaffin cells. Thereafter the tumor was called argentaffinoma (1914). Raiford reported the first clinical case of a malignant carcinoid tumor of the stomach (1933). Pettinari of Italy is credited with removal of a gastric carcinoid from a patient with complete pyloric obstruction (1935). Two years later Entwisel successfully removed multiple carcinoid tumors from the stomach of a young woman. Until 1939, a review of the literature by Plaut revealed only nine carcinoid tumors of the stomach. Lemmer, of Wisconsin, surveyed thirty-one cases of carcinoid. Of this number only one was located in the stomach. This was a benign lesion. We are presenting what we believe to be the eleventh carcinoid tumor of the stomach and one of the few to display evidence of malignancy.

PATHOLOGICAL PICTURE OF CARCINOID

This type of tumor confines its location to the gastrointestinal tract. The appendix is a common site, the small and large intestine are the next most frequent locations. Infrequently they are found in the rectum. Rarely is the stomach involved. Originally, carcinoids were accepted as benign tumors. This belief is no longer tenable. Many cases have been reported in which carcinoid tumors displayed malignancy and metastasized to lymph glands and the liver. At present according to some reports 17.5 to 20 per cent of carcinoids are malignant.[2,4]

Ewing states: "carcinoids are generally found at autopsy, when they appear as small, firm, yellowish, circumscribed nodules from 0.5 cm. to 1 cm. in diameter. These tumors are situated in the submucosa and muscularis covered with smooth mucosa and thickened peritoneum. Larger tumors may protrude into the intestine or peritoneum, or encircle and constrict the lumen, or infiltrate the surrounding tissues. Occasionally they are multiple."

The microscopic pathology of carcinoid has been studied by many investigators. Masson published a series of papers, from 1914 to 1930, in which he interpreted these tumors are arising from an endocrine gland connected with the sympathetic nervous system. Cells were found which contained many argentophile granules (argentaffin cells or cells of Kultschitzsky). Masson

noted the association of the tumors with tumor-like proliferation of the terminal nerve-fibrils, producing a form of obliterat-
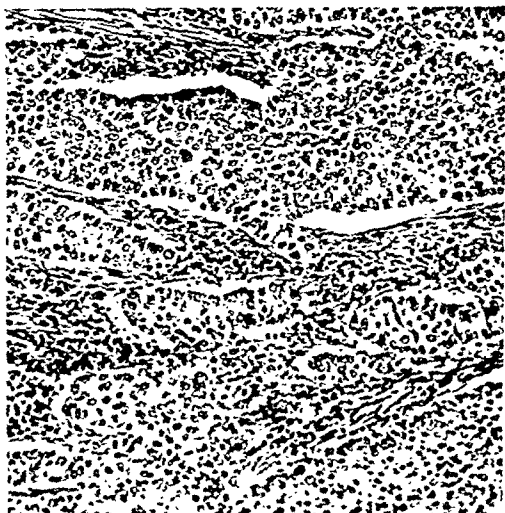

FIG. 1. Ovoid and polygonal shaped cells arranged in cords and alveolar-like masses. Hyperchromatic nuclei and mitotic figures are visible. (150 ×)

ing appendicitis. He described an apparent interchange of argentaffin cells between the epithelial fibrils and the nerve-filaments. He conceived this structure to signify a functional union between the glands and the sympathetic nervous system.[2] It is generally agreed that this type of tumor arises from the chrome cells near the basement membrane of the crypts of Lieberkuhn in the gastrointestinal tract.[4]

A carcinoid may present histological features suggesting a low grade melanoma or a basal cell carcinoma. Structurally they present groups of epithelioid cells, cuboidal or cylindrical, granular and argentophile, arranged in small groups indistinctly acinar, or in broader cords, or at times in palisade form.[2]

CASE REPORT

The patient was a white female, sixty-eight years of age, who was admitted to Kings County Hospital of Brooklyn, New York, on August 5, 1942, and discharged from the surgical service on September 13, 1942.

Her chief complaints on admission were weakness, and fatigue for the preceding three months, with a loss of seventeen pounds in

weight over a period of seven months. Since May, 1942, she was observed and treated by a family physician for anemia. She was finally
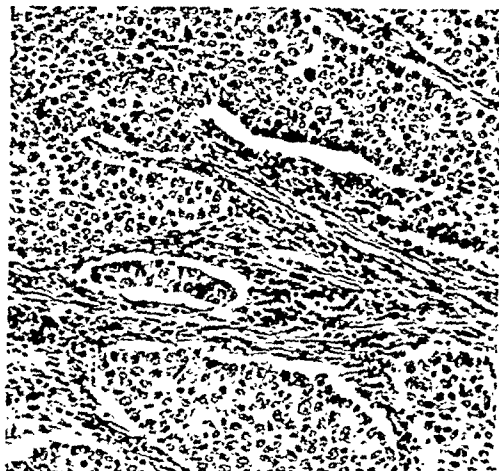
FIG. 2. Invasion of the muscularis by carcinoid cells. Central tumor embolus seen in a vascular channel. (150 ×)

sent to the hospital because of a marked anemia due to "possible internal bleeding." The past history elicited no factors pertinent to her present illness.

Physical examination revealed a well developed, obese, white female, clinically anemic, not in acute distress. The salient physical findings were: Blood pressure 155/95; pulse 92; respirations 24; temperature 100°F. Heart sounds were of good quality with slight increase in the first sound at the apex. No masses were palpable in the abdomen.

Laboratory data revealed the following: Red blood cells 2,900,000, hemoglobin 7 Gm., (hypochromia and microcytosis present) white blood cells 8,750; 84 per cent polymorphonuclears, 16 per cent lymphocytes; the urinalysis showed specific gravity 1.017; albumin one plus, microscopic negative; blood chemistry: urea 38, creatinine 1.24, sugar 87 mg. per cent.

Gastric analysis on August 12, showed no free hydrochloric acid in any specimen, no lactic acid, no blood and no bile. The total acid values in five specimens were respectively 7, 14, insufficient, 13, 10. The second analysis on September 2, showed one plus blood in all specimens. The total acidity was reported in five specimens as 5, 16, 5, 19, 10.

The electrocardiogram demonstrated left axis deviation. Roentgenograms revealed a constant irregular cauliflower-like, plum-sized

defect in the contour of the stomach. This was located in the pyloric region of the greater curvature. The picture was compatible with a new growth.

Barium meal showed a six-hour partial retention of stomach contents and confirmation of the above mentioned constant irregularity. The head of the barium meal was in the transverse colon, the tail was seen in the terminal ileum.

On August 25th surgery was undertaken. A subtotal gastrectomy was performed for pre-pyloric malignancy (posterior Pólya type gastrojejunostomy). At the operation the suprapyloric lymph glands were enlarged, firm, and suggested metastases from the stomach. No nodules could be found in the liver.

Postoperatively the patient was given a prescribed standard routine and was discharged on September 13th. Radiation therapy was suggested postoperatively but not given. The temperature was elevated for six days post-operatively, rising to 102.8°F. on one occasion. From the eighth postoperative day to the date of discharge the temperature was normal.

Pathologically, the specimen consisted of a portion of stomach with a neoplasm noted in the pyloric region. The neoplasm was projecting into the lumen and arose from the mucosa. The mass was cauliflower-like in appearance and measured 4 by 6 cm., it was pedunculated in character, firm and grayish white in color. The surface was mottled. The distal part of this mass was crater-like in contour; the borders of the crater were hardened. This new growth was easily demarcated from the apparently normal surrounding mucosa.

Microscopic examination revealed the section to be one of the stomach in which there was noted a neoplasm composed of ovoid and polygonal shaped cells arranged in diffuse and alveolar-like masses and in cords. Running between the cells was a stroma composed of rather dense fibroblastic tissue dividing the cells into alveolar-like masses. Some of the cells showed hyperchromatic nuclei but all the cells did not appear to be malignant in character. These cells were present in the muscularis and suggested invasion of this layer.

Diagnosis: Carcinoid of the stomach (malignant). (Figs. 1 and 2.)*

CONCLUSION

A case is presented which after clinical and laboratory studies substantiated the preoperative diagnosis of an obstructing gastric malignancy. At the operating table the impression was confirmed showing, in addition, metastases to the regional lymph glands but not to the liver. A subtotal gastrectomy was performed. Histological studies revealed the lesion to be a malignant carcinoid.

The patient was discharged nineteen days following operation. At this writing, more than one month later, the patient is living and well, has maintained her weight and has no difficulty in retaining a regular soft diet.

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* In view of the fact that the gross specimen was believed to be a true carcinoma, no silver stains were made. Later when the diagnosis of carcinoid was entertained silver stains were attempted but the resulting slides did not permit photomicrographs of merit. We regret, therefore, the absence of an illustration demonstrating argentaffin cells.

SECONDARY OR DELAYED HEMORRHAGE FROM A RUPTURED SPLEEN

CASE REPORT

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THIS case adds one more to the accumulating records of delayed hemorrhage from a ruptured spleen.

CASE REPORT

R. H. (Nazareth Hospital 2822), a white male of twenty-nine was first seen on July 9, 1941 in his home. He was lying on his side in bed with his knees drawn up and seemed reasonably comfortable in this position and was smoking a cigarette. He recited his history readily and answered questions promptly. His color was fine and he was in no wise shocked. His greatest discomfort was in changing position during which process he had a great deal of upper abdominal pain. The story he gave was this: After having had breakfast at a restaurant on his way to work the night before he had broken out in a cold sweat as he walked down the street and shortly thereafter was seized by abdominal pain which was generalized and which doubled him up. A little later he felt the pain in both shoulders. He hailed a fellow bakery-wagon driver who took him in his wagon to the stable where friends gave him a liquid to drink which he promptly vomited. He went out on the route, having a helper do the driving but stopped at a hospital receiving-ward where he was examined, given some pills and told to return the next day. He noticed a striking thing by this time, namely, his abdomen was getting larger and that his "pants felt tight." Opening the top buttons he felt better but later when he tried to close them he could not do so. His abdominal and shoulder pain persisting, the man decided to go home and got a taxi. On the journey to his house he knelt in the back of the cab clutching his abdomen to relieve the intense pain as much as he could. At home he got right into bed and in the morning called his doctor. The doctor on examining him noted a marked rigidity of the muscles of the abdominal wall and believed that he was dealing with a ruptured peptic ulcer and called me to see the patient. I found him as I have already recited and was likewise struck by the board-like rigidity of the abdominal wall. Believing, too, that we were dealing with a ruptured peptic ulcer and being concerned over the number of hours which had elapsed since the onset, I arranged immediately to send the patient to the hospital, and as soon as possible after arrival to the operating room. The general condition being very good (temperature 99°F., pulse 118, respirations 26, red blood cells 4,430,000, hemoglobin 71 per cent, white blood cells 11,900, polymorphonuclears 76 per cent, lymphocytes 13 per cent, rods 11 per cent), no preliminary measures were considered necessary but a set-up for giving intravenous glucose during the operation was provided.

With the patient under spinal anaesthesia a high right rectus incision was made. Through the peritoneum black liquid could be seen which on the opening was obviously blood—fresh and clotted mixed. The quantity was large. The liver was explored and found unbroken. The omentum, which directs as well as protects, was found turned upward and leading to the spleen. A rent could be felt in the surface of this organ. The peritoneum was then closed and another opening made in the left hypochondrium paralleling the rib margin. Fortunately, with fingers grasping the pedicle, the spleen could be elevated and freed rapidly because bleeding was now marked, coming from the surface of the spleen along the edges of a deep rent, and also from the depth of this clot-filled rent near the pedicle itself. The pedicle was clamped and the spleen severed. A heavy silk tie was used for the pedicle. Residual bleeding in splenic vessels and from the pancreatic surface was controlled by finer silk suture-ligatures. Through all this the patient's general condition remained excellent; there was no apparent shock. Nitrous oxide-

ether anesthesia had had to be resorted to shortly after the first incision was made, no true relaxation having been secured from the spinal (150 mg. procaine crystals). Intravenous glucose 5 per cent in normal saline was being given from the start of the operation. After the splenectomy all blood and blood clots were allowed to remain in the peritoneal cavity. Both wounds were now closed (just the peritoneum itself having been previously closed on the right). No drains were inserted.

The patient's recovery was marred by a bronchopneumonia combatted successfully with sulfathiazole, by a secondary anemia (lowest red blood count 3,770,000, hemoglobin 67 per cent) for which repeated transfusions were given and by a superficial collection of serum and serosanguineous material in the left sided wound. The patient left the hospital on his twenty-fourth day and recovery was complete; the wound healed completely, and the patient was walking, etc., three weeks after that.

REMARKS

Upon going into further details in the history, particularly as to the question of preceding trauma, the following story was obtained: On June 25, 1941, about two weeks before the onset of his present trouble, the patient had been watching a sand-lot baseball game from the players' bench along the first base line and had been struck in the lower left chest (indicating a point over the spleen) by a line drive foul ball. He felt as if the wind had been knocked out of him but after the players had rubbed his side he felt all right and walked four blocks to his home "stopping for a beer on the way." Later in the afternoon he took his children for a walk, returned home, ate a good dinner and retired at 7 P.M. About 10 P.M. he awoke with a feeling that he could not get his breath but when he got up and walked around a while this left. At work later that night he had shoulder pains on lifting heavy baskets but attributed the pains to draughts. From then on he worked every night although his shoulder pain was present daily at some time or other. For four days before his severe pain he had had epigastric pains suggesting to him that "something was stuck there." Then came his trouble as already related.

It presented one sign other than the classical ones which may have some significance—the noticeable rapid distention of the abdomen—to the point at which the patient could not re-button his trousers.

As with many other such cases it was mistaken for a ruptured peptic ulcer. If a more careful history had been elicited this might not have been the case, although the ulcer diagnosis could not have been eliminated entirely.

The absence of shock and signs of hemorrhage preoperatively is noteworthy. One would have expected these. Perhaps the second hemorrhage had arrested itself, although the blood loss had not been small, and the active bleeding seen when the spleen was exposed may have been due to the reopening of vessels by operative manipulation itself. Silk was chosen especially because of the exposed pancreas in fear of early digestion of catgut.

The leaving in of the blood and the omission of drainage worked out very well here, the abdomen was soft in forty-eight hours and remained so except where the serous collection occurred.

BONE MARROW AND FAT EMBOLISM FOLLOWING FRACTURE OF THE FEMUR*

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MANY reports of fat embolism following fracture of the long bones of the lower extremity are in the

FIG. 1. Microphotograph showing piece of bone marrow in branch of pulmonary artery; hematoxylin and eosin; × 108.

literature. Occasional reference in textbooks and in the literature is made to the general subject of tissue embolism but we were able to find only one report[1] on the occurrence of bone marrow embolism.

We have recently observed a case of bone marrow embolism accompanied by fat embolism following the operative reduction of a fracture of the neck of the femur.

CASE REPORT

The patient was an eighty-six year old female who was admitted to the hospital on June 8, 1942 because of pain in the left hip and inability to walk following a fall on the previous day. The roentgenogram showed a fracture of the neck of the left femur. An open reduction, which included the insertion of two three-inch wooden screws, was performed on June 8th. The patient ran a low grade fever until the day of her death on June 12th.

The external postmortem examination of the body revealed a recent skin incision over the lateral aspect of the left great trochanter. The left lower extremity appeared to be in fairly good alignment. The wooden bone screws were firmly embedded into the fragments and only slight mobility at the point of fracture could be elicited. The only other gross finding of any consequence was a moderately dilated 425 Gm. heart.

Microscopically, an early bronchopneumonia and a 2 mm. leiomyoma of the capsule of one kidney were the pertinent findings of general interest. Four sections of lung tissue were studied. Each of these showed numerous droplets of fat in the capillaries when stained with Sudan IV. In each of two 1 to 2 mm. branches of the pulmonary artery, a mass of bone marrow was present. Besides the myelocytic and erythrocytic elements, these contained megakaryocytes as well as macrophages with phagocytosed hemosiderin pigment. The larger piece contained nine fat cells. (Fig. 1.) Some of the glomerular capillaries and the arterioles in the kidneys also contained droplets of fat when stained with Sudan IV. No fat was found in the vessels in the heart and liver.

COMMENTS

The immediate cause of death was probably a combination of factors which included the advanced age, shock, operative procedure, bronchopneumonia and fat embolism. The bone marrow embolism

played little or no part in the cause of death.

We were unable to determine whether the bone marrow embolism occurred as a result of the fracture itself or as the complication of the operative procedure. The mechanism of entry was probably by way of the lacerated veins in the bone, the mouths of which remain open prior to occlusion by thrombosis. This is the com- monly accepted mechanism for fat embolism as a result of trauma to bone. The fragments of marrow could have entered the vein either spontaneously or were forced into it mechanically by the bone screws.

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APPENDICAL, bowel, biliary, and renal obstructions give rise to an intermittent crampy pain. The acme of the colic is of variable duration, lasting usually for several seconds to a few minutes. In lesions that assume the character of an inflammation with the elapse of time, there is usually as well a constant distress between the colics. The distresses occasioned by the various acute abdominal ills do not lend themselves well to comparison.

VON RECKLINGHAUSEN'S NEUROFIBROMATOSIS

A CASE OF HEPATOMEGALY AND SPLENOMEGALY

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VON Recklinghausen's neurofibromatosis is a complex syndrome, capable of protean manifestations, and is more common than has been supposed. Of approximately 500 men and women ranging from seventeen to fifty-five examined for employment in a department store and an industrial firm during a period of one month, the author noted that eight of them, three male and five female, or about 1.6 per cent presented stigmas, as skin pigmentations, café-au-lait spots, and multiple cutaneous neurofibromas. Basing our total population upon this figure, there are approximately 1.75 or 2,000,000 individuals with this condition.

Sharpe and Young[1] quote a great number of isolated cases presented in the literature. Yet the incidence of the syndrome must be greater than recorded as many, presenting evidences of neurofibromatosis come to the physician because of something else and are, therefore, classified under other headings. Gardner and Frazier[2] (1930), in a review of the literature, were able to collect forty-four cases of bilateral tumors of the acoustic nerve, thirty-seven of which were associated with neurofibromatosis. Van Bogaert[3] (1934), and De Klejn-Gray[4] (1932) reported additional such cases. Davis[5] has shown that about 10 per cent of the cases of tumors of the optic nerve reported in the literature (five in his own series), were associated with neurofibromatosis of the peripheral nerves. Lesions within the brain, gliosis, gliomas, and meningiomas, have also been reported.[5] The upper eyelid and region about the orbit and temple are common sites of these growths.[5] Defects in bony structure, scoliosis, irregularity in the shafts, and differences in the length of the long bones have been described.[6,7] Soft nodules in the skin, known as molluscum fibrosum and café-au-lait patches, may accompany the more obvious tumors of the nerves, or they may be the only visible evidence of the disease. The endocrine and autonomic associations with neurofibromatosis have been stressed by Levin and Behrman.[8] Involvement of the pituitary,[9] thyroid and pancreas[10] have been noted. A high incidence of feeble-mindedness has been recorded in those showing marked involvement.[11] Heublein et al.[12] reviewed the roentgenographic findings of the condition.

Etiology. The cause of the disease remains unknown. It is of hereditary nature, and follows the Mendelian law as a dominant trait.[11] Sharpe and Young[1] suggest that from a congenital or inherited mesodermal abnormality, an embryonic tissue arrest is formed, which at birth, childhood, puberty and pregnancy may be clinically manifest, depending upon its response to the stimulation of the normal physiologic growth factor. Neurofibromatosis appears in both sexes, and makes itself apparent, as a rule, at the time of puberty; however, in many instances, the manifestations appear, or first become evident in middle life. It is further characterized by the numerous complications which may develop during its evolution and the progressive character of its course.

Pathology. It is beyond the scope of this paper to enter into a detailed discussion of the origin of the tumor. This point has occasioned debate for many years. A satisfactory classification of these tumors is

difficult, owing to the complex structure of the nerve trunks and the uncertainty of the source of the supportive cells which accompany nerve fibers.[13] Penfield[14] and others support the mesodermal origin of the tumors from the connective tissue sheath of nerves (perineurium). Masson,[15] on the other hand, believes that the tumors arise from the cells of the sheath of Schwann, and are therefore ectodermal in origin.

Best known are the skin lesions, the characteristic soft or elastic nodules, known as molluscum fibrosum, and pigmented patches in the skin, smooth nonelevated light coffee colored. The presence of these alone, without other manifestations, are most often encountered. Some authors consider the presence of these two alone or as incomplete forms or formes fruste of the disease.

The tumors may be of various sizes. They most often affect the peripheral nerves and are scattered over various parts of the body. Lesions within the brain, gliosis, etc., may be present. In general, neurofibromas are benign encapsulated tumors. Sarcomatous degeneration occurs in from 12 to 13 per cent of patients showing stigmas of Von Recklinghausen's disease.[16] Except in the lungs these sarcomas extend by local invasion rather than metastasis.

Cranial nerve palsies and clinical signs of pressure of the tumors are not uncommon. They depend upon the location and size of the tumors. Cortical involvement, with resulting defective memory, idiocy, and association with tuberous sclerosis have been noted.

Multiple neurofibromatosis is a disease of many organs, and endocrine dyscrasias, such as myxedema, diabetes mellitus, acromegaly and involvement of the adrenal glands may be part of the clinical syndrome.

Defects in hearing, due to bilateral acoustic neurofibroma and defects in sight due to tumors of the optic nerve may be associated symptoms.

A great variety of bone abnormalities due to the involvement or erosion of the bone may be encountered. Hyperplasia of bone shafts occur including changes which in the x-ray film appear as bone cysts. Moore[7] believes that the bony changes are not merely associated with but are the result of the changes in the nerve, either directly or indirectly.

The syndrome may sometimes be an accidental discovery in the course of a routine x-ray examination. Such is the case of an intrathoracic neurofibroma reported by Lavender and Prentice.[17]

Pressure upon important structures, hemorrhages into a pachydermatocele, infections in the large tumors and malignancy may complicate and obscure the picture.

CASE REPORT

The patient, a forty-eight year old married woman, white, was first seen by the author at the Out-Patient Clinic in May 31, 1941, having been referred by the Chest Follow-Up Clinic for an opinion on her thyroid enlargement. Her personal history revealed several admissions to the Mt. Sinai Hospital because of hemoptysis. The first in 1932, revealed the cause by bronchoscopy, as a globular mass, semipedunculated and easily bleeding, covered by normal mucosa located in the right lower bronchus. Biopsy showed adenoma with angiomatous stroma. She had several one-day admissions for bronchoscopy thereafter. Physical examination during 1932 to 1940 revealed no other abnormality. Her present complaints were choking sensation in the throat of six months' duration with increasing irritability and nervousness.

No pathological disorder was noted except for a slight nodule on the right lobe of the thyroid gland, and the clinical impression after the first examination was a nontoxic thyroid adenoma. The patient was seen again several months later, and no change in her thyroid status was noted. She, however, complained of increased menstrual bleeding with clots and was therefore referred to the gynecological clinic. She was later admitted to the hospital in January, 1942, for her gynecological complaints. The records at this admission showed a painless hepatomegaly and splenomegaly of unknown origin, with a uterine fibroma, but no skin lesions. A dilatation and curettage were done. Roentgenologic examinations of the

chest were repeated and showed the same paramediastinal mass noted in 1932. She was again seen by the author in April, 1942. At this time she presented disseminated soft nodules in the skin with multiple café-au-lait patches, and in addition a spleen, palpable two fingers breadth below the costal margin, and a liver three fingers breadth below the costal margin. Upon questioning she stated that the skin lesions were of recent occurrence. These findings pointed to a multiple neurofibromatosis syndrome.

Comments. The case of neurofibromatosis presented, suggests a picture of a syndrome rather than the solitary manifestation of a disease. This patient has been studied and treated for several specific complaints intermittently over a period of ten years by various members of the hospital staff. There was no suspicion of neurofibromatosis until attention was focused on the disease by the appearance of multiple fibroma mollusci on the skin. The question may be raised whether her multiple complaints, the thyroid enlargement, benign tumor of the bronchus and uterine fibroids, may not be associated with neurofibromatosis. Most perplexing and unusual of all was the sudden appearance of a painless, hepatomegaly and splenomegaly. Is it coincidental that her enlarged spleen and liver occurred at approximately the same time that the skin lesions appeared? Or is it possible that this case is actually the evolution of the course of a progressive disease? Literature on the disease seems to indicate that no organ is immune to involvement.

Because it is rarely indexed, neurofibromatosis appears in statistics as a rarely encountered disease. The Mt. Sinai Hospital with an approximate total admission of 15,000 to 17,000 annually have three patients classified as having Von Recklinghausen's disease, as far back as the records go. On the other hand the author, in the course of 500 employment examinations over a period of one month found eight cases of the disease.

This discrepancy may be accounted for by the fact that neurofibromatosis in many instances may have been noted, but the emphasis was placed on the accompanying complaint, without any connection being suggested between the two. It is, therefore, the author's opinion that existing statistics do not reveal the true incidence of neurofibromatosis.

SUMMARY

1. Multiple neurofibromatosis is a constitutional disease with protean manifestations.

2. It is much more common than is supposed. The author's figure based on a survey of 500 people during a month's period, reveal it present among 1.6 per cent of the population.

3. Its chief features and most common signs are the soft, elastic, pinkish nodules along the course of peripheral nerves, known as molluscum fibrosum and pigmented café-au-lait colored patches. Other features are bony abnormalities especially scoliosis, endocrine dyscrasias, mental changes and defects in hearing and sight.

4. The disease is hereditary and is present in both sexes. It appears as a rule at puberty or in middle life.

5. A case is reported associated with a hepatomegaly and splenomegaly along with the common skin manifestations.

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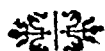
Distension, nausea and vomiting with feculent regurgitation accompanied by *intestinal colic* indicates the presence of obstruction of the small intestine. Distension, frequently of high grade, unattended by nausea or vomiting, with no return of colored intestinal fluid on gastric aspiration, but, accompanied by *intestinal colic*, is synonymous with obstruction of the colon.

SOLITARY NEUROGENIC SARCOMA OF THE MESENTERY*

REVIEW OF THE LITERATURE AND REPORT OF A CASE

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NEUROGENIC sarcomas arise from the nerve sheaths of either somatic or sympathetic nerves and so may occur anywhere in the body. Only infrequently do they occur in the abdominal cavity and but rarely in the mesentery. There are only four cases of neurogenic sarcoma of the mesentery reported in the literature since 1909. Not all of these stand up under close scrutiny, and none of these was a solitary tumor at the time of surgery. In 1909, Harbitz[1] reported a case of generalized neurofibromatosis in which the patient died of carcinoma of the ovary with peritoneal metastases. At postmortem examination a large nodular tumor mass was found in the mesentery which microscopically was not carcinoma, but consisted rather of spindle cells and probably was a sarcoma. Whether it was a true neurogenic sarcoma remains a subject of controversy. In a critical review of the literature in 1931 Stewart and Copeland[2] do not include any neurogenic sarcomas of the mesentery.

In 1936, Sailor[3] reported a case of multiple neurogenic sarcomas in the mesentery, liver and omentum. Subsequently, Warren and Commer,[4] in a review of 163 cases of fibrosarcoma, reported one neurosarcoma of the mesentery without any details as to its location, whether or not it was solitary, or its pathologic picture. They only state that the patient died. Then Ransom and Kay[5] reported a case of neurogenic sarcoma in the mesentery of the terminal ileum, and when the patient expired seventeen days after surgery, metastases were found in the liver and on the subdiaphragmatic peritoneum.

The case to be presented is unusual in that at the time of surgery a large solitary neurogenic sarcoma was found in the mesentery of the jejunum without metastases and that the patient died of metastatic involvement one year and nine months after its removal.

CASE REPORT

G. R., a sixty-two year old white male, entered Michael Reese Hospital on July 23, 1939, complaining of chills, fever, and right lower quadrant pain during the twelve days prior to admission. He stated that he had been in good health until twelve days previously when he was suddenly seized with a shaking chill lasting thirty minutes. His temperature rose to 103°F. orally, and he developed a constant aching pain in the right lower quadrant which was aggravated by sudden deep breathing or movements. The pain persisted, and the patient continued to have chills and fever until the time of admission. The patient had regular bowel movements until this episode, but since then was constipated and required enemas.

Physical examination revealed the following: temperature 100°F. rectally, pulse 90, respirations 26, blood pressure 130/80. The patient was a well developed, obese sixty-two year old white male lying quietly in bed and perspiring somewhat. He appeared to be rather drowsy but readily awakened to answer questions very co-operatively. There was no dyspnea, cyanosis, jaundice or pallor.

There were no tumors or discolorations of the body surface. The head, neck, and chest were normal. The abdomen was very obese. The liver, spleen, and kidneys could not be palpated. There was a mass present in the right lower quadrant with marked local tenderness here. There was no rebound tenderness and no fluid present in the abdomen.

Red blood cells were 4.6; hemoglobin 70 per cent, white blood cells 27,250, neut. polymorphonuclears 85, basophiles 1, lymphocytes 11,

Fig. 1. Film showing cyst and entire colon filled with barium.

monocytes 2, urine negative. The stool showed some occult blood in three out of four samples.

The patient ran a septic temperature, between 103° and 99°R for fourteen days. The only therapy was bed rest.

On July 24, 1939, the blood sugar was 100, nonprotein nitrogen 36, icteric index 5, Wassermann and Kahn tests were negative.

On August 9, 1939, the chest fluoroscopy was negative.

With barium enema the opaque clysma passed easily retrograde to the cecum and on the right apparently encircled a dense shadow which measured at least 8 to 9 cm. in diameter. This tended to displace the transverse portion of the colon slightly upward. The cecum and ascending colon were apparently not attached to the mass. There were several very small diverticula in the sigmoid. The mass seemed to lie along the right iliopsoas margin below the transverse colon and had a large (5 to 6 cm. diameter) cavity which was apparently filled with air or gas. The mass was distinctly away from the outline of the cecum and ascending colon, so that it appeared unlikely that the lesion had for its origin a perforation of the cecum or appendix. (Fig. 1.)

The patient's fever finally subsided, and so

he was discharged on August 15, 1939. He was readmitted on October 15, 1939, for a series of gastrointestinal x-rays. He had been

Fig. 2. Film showing proximal and distal communications of cyst with small intestine. The proximal and transverse portions of the colon also are outlined by barium.

losing weight and had been running a septic temperature since his discharge.

X-rays taken on October 18, 1939, revealed a large irregular area of barium accumulated in the right lumbar region and having the appearance of a large encapsulated cavity associated with the small intestine through perforation.

Impression: The possibility of perforation of the small intestine with abscess formation and encapsulation, or breakdown of a mesenteric cyst with rupture into the small intestine must be considered. (Fig. 2.)

The patient was again readmitted on November 15, 1939, because he had lost thirty-five pounds in weight since July and still continued to run a septic temperature up to 103°F. daily.

Physical examination revealed the temperature 101.4°F., pulse 88, respiration 20. The mass was still present in the abdomen extending about 4 cm. above, below, and to the right of the umbilicus.

On November 9, 1939, an exploratory laporotomy was performed by Dr. Morris L. Parker. A large mass about the size of a fetal head was found to which the small bowel and

colon were adherent. Liver, spleen and other organs were negative. The mass was dissected free and was found to be grey in color and
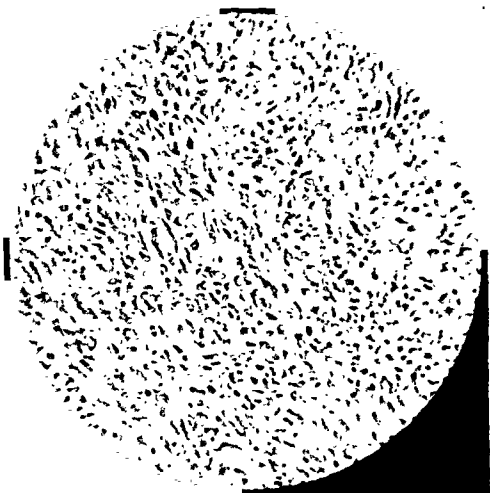

FIG. 3. Microphotograph showing typical spindle-shaped cells.

having an abscess cavity containing about 500 cc. of fecal—smelling, dirty, brownish pus in which fruit seeds were noted. The thick wall was of mushy consistency and from it extended many grape-like masses of tissue of similar consistency. The jejunum was intimately adherent to this mass and communicated with it through two fistulas. The proximal opening in the jejunum was twelve inches distal to the ligament of Treitz and the other opening was twelve inches distal to this. The jejunum was separated from the mass, and it was found to be negative except for inflammatory tissue. This inflammatory tissue was removed from the openings, and they were closed with intestinal catgut. The origin of the tumor was in the root of the mesentery close to the third and fourth portions of the duodenum. No enlarged lymph nodes were noted. The mass then was peeled off the posterior leaf of the mesentery of the transverse colon and removed. The abdomen then was closed. The patient received 500 cc. of citrated blood and 1,000 cc. of 5 per cent glucose in saline during the operation and left the operating room in good condition.

The postoperative course was complicated by a fecal fistula which was kept clean by continuous suction and was closing at the time of discharge.

The pathologic report showed the specimen to consist of a piece of tissue measuring 24 by 14 cm. One surface presented multiple nodular

formations peering through the wall, measuring 3 cm. Elsewhere this surface presented multiple tags of fat with many hemorrhagically discolored areas. The wall was 3 cm. thick. The other surface throughout its extent consisted of a mass of ridges and nodules and was semifirm.

Microscopically, in the sections, predominantly spindle shaped cells were arranged in masses separated by thin strands of outspoken fibrous connective tissue. The fields varied in cellularity, the spindle shaped cells were either closely approximated or separated by a loose or vacuolated tissue. They varied markedly in size, had long neutrophilic interweaving cytoplasmic processes, and elliptical, often somewhat blunt-poled nuclei. The chromatin formed a fairly thick network. Nucleoli were often seen. Mitotic figures were fairly frequent in some areas. The cells were arranged in sheets, whorls and strands. Extravasated red blood cells and thrombosed vessels were noted beneath the inflammatory border.

Diagnosis: microscopic—neurogenic sarcoma. (Fig. 3.)

Postoperatively the patient was in good health and gaining weight for nine months, during which time he left the city. He then began to lose weight, developed multiple fistulas in the area and multiple tumors could finally be palpated within the abdominal cavity and liver. He expired one year and nine months after surgery and no autopsy could be obtained.

REMARKS

The pathologic picture of neurogenic sarcoma has been well classified by Stewart and Copeland.[2] Much argument still exists as to whether they are of neuro-ectodermal or mesodermal origin. Excellent reviews of the evidence are presented by the above authors and by Ransom and Kay.[5]

Neurogenic sarcomas are notorious for tending to remain locally malignant and recurring after inadequate surgical removal, but failing to give rise to distant metastases. Stout[6] found that 74 per cent of peripheral nerve neurogenic tumors recurred following excision, but in only 20 per cent did they show evidence of metastases. This apparently is not true for those within the mesentery, for of the four previously reported cases, only three can be

analyzed, and all of these had metastases in various locations including the liver. In our own case thorough exploration at the time of surgery failed to reveal any metastases, although the patient died with multiple metastases one year and nine months later.

In removing tumors of this type it is well known that wide excision is necessary. If the involved nerve is found along with the tumor, it should be resected as far as possible, since numerous recurrences have been noted after removal, frequently in the distal nerve segment.

CONCLUSIONS

1. Solitary neurogenic sarcoma of the mesentery is rare, this being the only reported case of this type.

2. In this case the patient presented none of the other stigmas of von Recklinghausen's disease.

3. Diagnosis of a cystic tumor communicating with the small intestine was made roentgenographically preoperatively and proved by surgery.

4. Successful surgical removal was carried out, the patient dying of metastases one year and nine months later.

5. Neurogenic sarcomas of the mesentery apparently differ from those occurring along peripheral nerves in that in all reported cases these possess a far greater tendency to give rise to metastases.

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LYMPHOSARCOMA OF THE STOMACH WITH PERFORATION*

GASTRIC RESECTION WITH RECOVERY

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TAYLOR collected through 1937, 152 cases of primary lymphosarcoma of the stomach from the literature. They constitute about 1.5 per cent of gastric neoplasms. The average age in his series was 44.3 years. The preponderance of males to females is approximately 3 to 2. Trauma of habits is believed to be an exciting cause. Pathologically, Warren and Lubenski have designated as primary lymphosarcoma; malignant lymphoma, Hodgkin's disease, lymphosarcoma and reticulem cell sarcoma. The primary differentiation is whether the tumor arises from lymphocytes or reticulem cells in the lymph follicles found in the submucosa. The growth infiltrates all layers. It causes a thickening of the submucosa causing the giant rugae seen in the roentgenograph. It tends to be a bulky growth with shallow broad ulceration which deepens rapidly with necrosis due to infiltration of the submucosa. It is usually found along the curvatures in the prepyloric area. Pyloris stenosis is rare. Perigastric and adjacent retroperitoneal nodes are most frequently involved by extension.

Clinically, pain of ulcer type is most commonly found. Dyspepsia and anorexia are common; vomiting is not obstructive; weight loss is moderate; perforation is more frequent than in carcinoma and a mass is commonly present. Free hydrochloric acid is usually present and there is no definite roentgenological picture, although giant rugae are marked. Gastroscopy is not conclusive.

Radical subtotal gastrectomy followed by intensive deep radiation therapy is the treatment of choice. Pack and McNeer recommend a total dosage of 2,500 to 4,000 r. Radiation therapy gives remarkable results alone and radiation may well be used repeatedly.

Taylor reports an approximately 10 per cent cure in consideration of all cases. Recent series report 40 to 50 per cent cures. Koucky Beck and Atlas distinguish three types of cases: (1) the acute perforation with peritonitis; (2) the perforation which walls itself off with transient peritonitis, and (3) the perforation into another structure without communication into the abdominal cavity. There are two cases each of the first two types. It is my opinion this case would have fit into the first type if the perforation had been of longer duration.

CASE REPORT

A forty-nine year old male presented himself at my office on January 20, 1941, with the following story: He had always been in good health, having had no previous illnesses in his life. One year previous to his visit, he had had gradual onset of cramp-like pains in the epigastric region. These pains would radiate through to his back, and when the cramp character had subsided, would leave a background of dull, upper-abdominal pain. The intensity of the pain had gradually increased, and with it had appeared gaseous eructations, flatulence and nausea. This was intensified by all types of food, and one day previous to this date water also aggravated the condition. There had been no vomiting. Stools were normal and there had been no tarry or bloody character noted. During the past year he had lost twelve pounds in weight. Two packages of cigarettes a day and a substantial alcoholic intake had been the custom for some years. There were no other symptoms.

Physical examination revealed a well developed, but very thin and malnourished white male. There were a few palpable but normal nodes in the anterior cervical chain but no lymphadenopathy. The abdomen was distended above the umbilicus and tympanitic. There was tenderness in the epigastrium, and a mass thought to be the stomach was felt in the region. The liver was not palpable, nor was the spleen.

X-ray films were taken the following day. The pertinent findings are as follows:

"There is a marked hypertrophy of the rugae throughout the entire stomach. The lesser curvature of the stomach appears pliable throughout although peristalsis is extremely irregular. On palpation there is an apparent mass which is moderately tender along the greater curvature of the stomach in the mid portion of the fundus. The greater curvature at this point appears somewhat indurated with no peristaltic waves passing along the greater curvature. There is a fairly large niche along the greater curvature in this region."

The patient was admitted on January 24th to St. Clare's Hospital and the stomach washed out twice the following day. On admission his temperature was 99.6°F., pulse and respiration normal, white blood count 13,400, 81 per cent polymorphonuclears, 80 per cent hemoglobin, 4,280,000 red blood cells. The patient was operated upon January 28th, the stomach being washed one hour before operation.

Operative findings were as follows: Exploratory laparotomy was performed under cyclopropane anesthesia. The stomach presented directly into the wound, and a perforation of an ulcerated area was seen to be present on the posterior wall of the stomach involving the greater curvature into the gastrocolic omentum. This perforation was apparently very recent. The position of this ulcerated area was in the middle third of the stomach, being near to the tail of the pancreas. When palpated an area the size of a silver dollar was found to be paper-tissue thin and another area twice

this size to be necrotic. The perigastric nodes were enlarged and firm but not stony hard. The liver and spleen and retroperitoneal nodes were apparently normal. A gastric resection was performed removing the lower two-thirds of the stomach and the first portion of the duodenum down to the pancreas with anterior gastroenterostomy.

Pathological Report. "Specimen was composed of a resected stomach including cardia end and most of the fundus and first segment of duodenum. The wall measures 3 mm. The mucosa is hypertrophied. The rugae are markedly prominent. There is an oval excavation area which measures $2\frac{1}{2}$ by $1\frac{1}{2}$ by 1 cm. The edges are round. The base is rather smooth. The mucosa surrounding this area is thickened and hypertrophied. There is a perforation extending through the entire wall. This measures 1 cm. in length, and extend through the serosa. The opening appears recent. There are enlarged lymph nodes around the gastrocolic portion.

"Microscopic—There is necrosis of the mucosa with diffuse infiltration of the mucosa, submucosa and muscularis with numerous lymphocytes and round cells. There is an increased amount of granulation tissue at the base of the necrotic mucosa. The lymph glands show evidence of an increased amount of lymphocytes within the medullary sheath and sinuses."

Several pathologists agreed that this was a case of lymphosarcoma arising from lymphocyte cells of the stomach and with metastasis in perigastric nodes.

The patient made an uneventful recovery, was given fluids in small amounts through a stomach tube six hours postoperatively. He was taking soft gruels on the third day, was on a light diet on the twelfth day, out of bed on the fourteenth, and discharged on the seventeenth.

X-rays of the chest were negative. The patient received 1,750 r. units of radiation in six treatments from March 10th to March 24th. Check-up x-rays taken one year later showed negative chest and gastrointestinal series.

APPENDICEAL LITHIASIS*

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IN 1915, Pfahler and Stamm[1] in a comprehensive review of the literature, were able to find only one case of appendiceal lithiasis which had been correctly diagnosed prior to operation and that by Weisflog[2] in 1906. Packard,[3] in 1921, published a paper titled "Appendiceal Lithiasis—Report of a Case, Unique in the Annals of Surgery." He carefully perused the medical journals of the previous twenty years and was unable to find a report of an appendiceal calculus approaching in size the one he described. His stone, which was not preoperatively diagnosed, measured 4 by 1 by 2 cm. Since then, there have been sporadic case reports in the American literature and for that reason, this case report and review of the American literature is in order.

CASE REPORT

The patient, M. J. S., a thirty-three year old white male, was inducted into the Army on April 5, 1942, and was admitted to the Station Hospital at Keesler Field on June 17, 1942. The family history revealed that a sister and brother were under treatment for gallstones. His past history was irrelevant. He dated his present illness to two years previous to his admission with the onset of recurrent attacks of epigastric and right lower quadrant pains which would radiate across the lower half of the abdomen having no relation to meals. These attacks would occur about twice weekly and last about one-half hour. Eight months ago, he experienced a very severe attack of right lower quadrant pain which was associated with nausea and persisted for two days. A physician was called who made a diagnosis of gallstone colic and administered a hypodermic injection with relief. Since then, he had had recurrent mild attacks associated with nausea. His appetite had been poor and he believed that he had lost about twenty pounds in weight during the past year. He had always been subject to constipation.

On admission, the patient was found to be undernourished, not ill appearing and in no apparent distress. Physical examination failed to reveal any abnormal findings except for slight tenderness in the right lower quadrant with no definite palpable masses. His temperature, pulse and respirations were normal. The white blood count showed 6,350 cells with the following differential: polymorphonuclears, 64 per cent; lymphocytes, 32 per cent, monocytes, 2 per cent and eosinophiles, 2 per cent. Urinalysis was negative. A gastric analysis (fractional alcoholic test meal) revealed that the peak of the acid curve was reached in forty-five minutes with 47 degrees free hydrochloric acid and 58 degrees total acidity.

An x-ray study of the gastrointestinal tract was then done. This revealed the stomach and duodenum to be normal. On the preliminary scout film as well as on the flat plate of the abdomen with the stomach filled with barium (Fig. 1) there was noted a round, laminated, opaque shadow measuring about 2 cm. in diameter in the right lower quadrant. At this point, it was believed that this most likely was a gallstone in the terminal ileum. However, at the six-hour observation (Fig. 2) it was seen that the calculus was definitely not in the ileum and it appeared as if the appendix, which was filled with barium in its proximal portion, extended into the stone. On fluoroscopy, the cecum, appendix and calculus were seen to be freely movable. It was then believed that the shadow represented an appendiceal calculus. To further corroborate this impression, a gallbladder series was done which showed a normally functioning organ with no evidence of any calculi present.

On July 20, 1942, under spinal anesthesia (Capt. C. E. Fierst, anesthetist), a right lower rectus incision was made (A. M. T.) and the cecum and appendix mobilized. There were no adhesions and the appendix showed no inflammatory changes but presented a dilatation in its proximal half caused by a firm oval mass within

its lumen. The distal half was normal and free. Appendectomy was carried out in routine fashion. The patient's postoperative course was

eral portion. Microscopic examination of the appendix through its proximal half failed to reveal any signs of an acute inflammatory
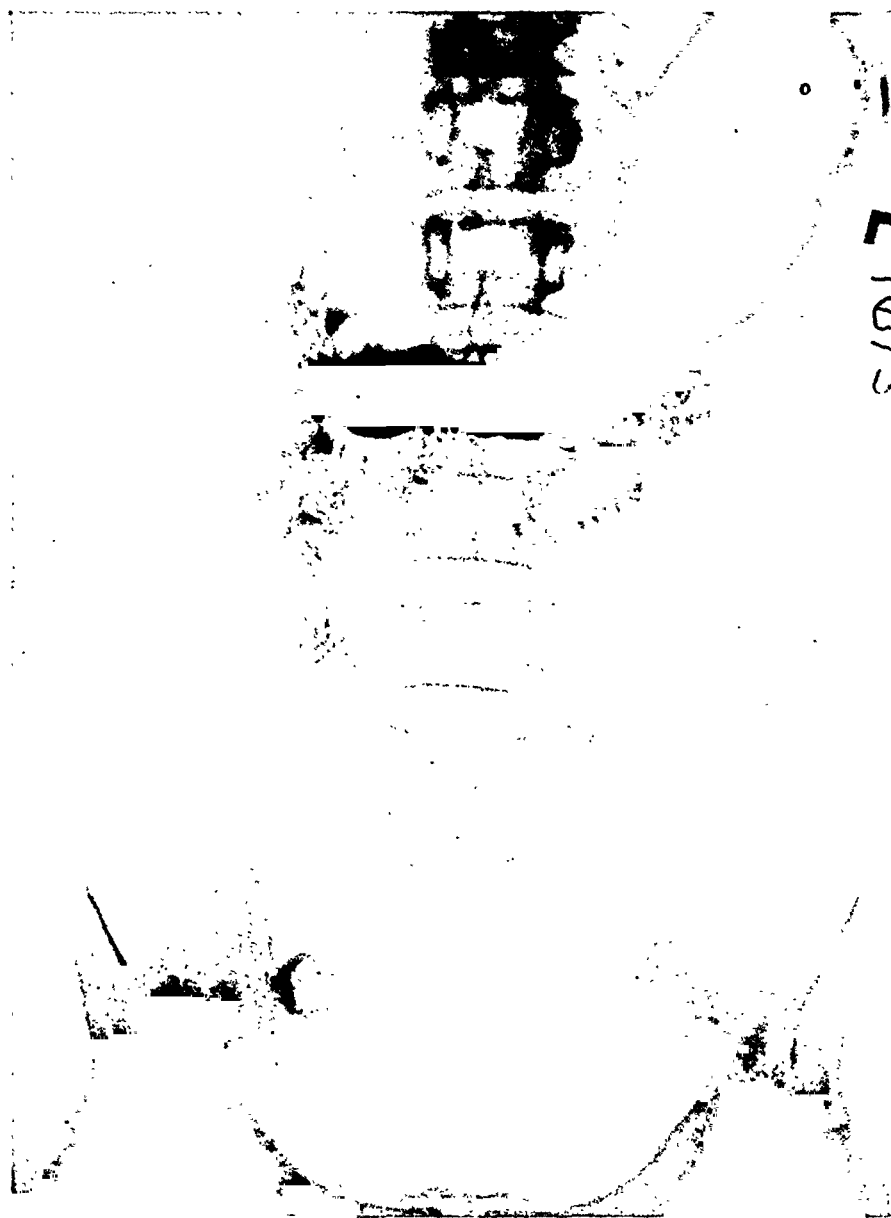

Fig. 1. Flat plate of abdomen with stomach filled with barium. Laminated, opaque calculus noted in right lower quadrant.

uneventful and he was discharged from the hospital on the twelfth postoperative day.

The pathologic report revealed the following: The appendix measured 5 cm. in length and 2½ cm. in diameter across the upper half. (Fig. 3.) On opening the organ (Fig. 4), a stony hard, irregular, round mass, 2½ cm. in diameter, dark brown in color with mottled darker and lighter areas was noted in the proximal half. On section, this stone had a shiny granular, light yellowish-brown central portion and a laminated, more coarsely constructed periph-

process. The thickness of the wall here measured 4 mm. There were noted scattered lymphoid aggregates with the mucosa infiltrated by large numbers of eosinophiles with fairly numerous plasma cells and occasional pigment-containing macrophages. A marked increase in fibrosis of the muscular wall was evident. A section through the tip of the appendix showed an atrophic mucosal epithelium with the mucosa infiltrated by numerous eosinophiles. The submucosa was converted into an irregular dense fibrous zone with

intervening areas of fatty tissue and the muscularis showed a marked increase in fibrous tissue. No analysis of the calculus was done.

laminated. They are also commonly larger than the normal appendix lumen.

Normally, the fecal particles which enter

FIG. 2. Spot film of ileocecal region at six-hour observation. The appendix is seen extending out to the calculus.

REMARKS

A definite distinction must first be drawn between what constitutes an appendiceal calculus in contradistinction to a fecalith. The latter are non-opaque concretions which are revealed as rounded, clear translucent areas in the barium filled appendix. They are usually multiple, small in size and rarely if ever larger than the caliber of the lumen. Statistics indicate an incidence of from 5 to 80 per cent, depending upon the type of disturbance found (Feldman[4]). On the other hand, appendiceal calculi are opaque concretions and are rarely found in the appendix. Bunch and Adcock[5] found only one such case in a series of over 2,000 cases studied. They are usually single, generally circular and although they may be solid stones, they may be

the appendix are returned to the cecum by means of peristaltic contractions of the walls of the appendix. If, however, the return of the mass is impeded in any way, the fluid is gradually absorbed and the mass becomes more or less inspissated. Due to the irritation of the mass and the associated bacterial activity, a low grade inflammatory process ensues resulting in increased secretion of mucus into the lumen from which, because of chronic stasis, inorganic salts are deposited on the surface of the dried fecal particle. This causes an increase in size of the calculus which as it enlarges, because of its obstruction, causes additional inflammation with more active secretion of mucus. Hence, the reason for the laminated appearance of many of these stones.

As to the composition of these concretions, Maver and Wells[6] examined three collections of concretions found in human

noted in previous cases, some having been preoperatively diagnosed as ureteral stones[10] and others, because of their lami-

FIG. 3. Appearance of the appendix after its removal. Tip of appendix held by forceps, with proximal portion dilated.
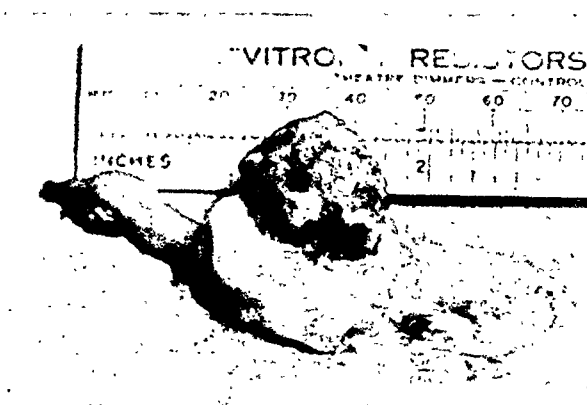
FIG. 4. Appendix after it had been opened to reveal the irregular, stony hard calculus in the proximal portion which was the cause of the dilatation.

appendices removed at operation and found that about one-fourth of the total weight was composed of inorganic material, chiefly calcium phosphate. About one-fifth was organic residue, mostly vegetable fiber and about one-half their weight soluble was fat solvents, chiefly soaps, koprosterol and cholesterol. The stones found by Vermooten,[7] Levi,[8] Wells[9] and Bunch and Adcock were found to be composed largely of calcium phosphate.

Diagnosis. A perusal of the case reports in the literature reveals that there are no characteristic symptoms which might be of diagnostic importance. Seven of the ten complete case reports reviewed gave a history of three months to two years' duration of recurrent cramp-like abdominal pains. One case presented symptoms for one week and at operation an appendiceal abscess was found. One case gave a history of two days' duration and an acutely distended organ was found whereas in the last case, there were no symptoms. The only certain method of diagnosing this finding is by x-ray examination. A flat plate of the abdomen will reveal the stone in the abdomen, the location of which will depend upon the position of the appendix. The variable position of the organ plus the occasional location of the stone in the tip of the appendix makes for the errors in diagnosis

nated appearance, as gallstones.[11,14] However, a barium study of the intestinal tract should reveal the location of the stone in relation to the appendix. A lateral film of the abdomen may aid in differentiating it from a ureteral stone and occasionally, urographic studies may be indicated in order to arrive at the correct diagnosis. The fact that inadequate x-ray studies were made accounts for the fact that only two[12,13] of the ten cases were correctly diagnosed. Both of these were found by means of a flat plate of the abdomen. Albert's case[14] had had a barium study of the stomach and duodenum but no six or twenty-four hour observations were made.

SUMMARY

It is believed that the diagnosis of appendiceal lithiasis must be entertained in every case of calcification found by x-ray in the right lower quadrant. Lateral x-ray of the abdomen and barium studies of the intestinal tract are useful diagnostic measures to be utilized in an attempt to arrive at the correct diagnosis. Once the diagnosis is made, surgery is definitely indicated as five of the cases reviewed showed an acutely inflamed organ at operation and one of these had ruptured with a localized abscess formation.

CONCLUSIONS

1. A case is reported of an appendiceal calculus which was preoperatively diagnosed.

2. A review of the American literature impresses one with the rarity of this finding.

3. The diagnosis of appendiceal calculus is discussed.

4. When definitely diagnosed, surgery is indicated as a superimposed acute inflammatory process with perforation may occur as a complication.

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MULTIPLE PRIMARY MALIGNANT LESIONS

TWO CASE REPORTS

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THE incidence of multiple malignant lesions is much higher than estimated by the average clinician who has had no special training in pathology. Kirshbaum and Shively[1] who have reported the largest autopsy series, found multiple malignant lesions in twenty-five, or in 1.77 per cent. The highest incidence of multiple malignant lesions has been reported by Burke[2] who found multiple malignant lesions in forty-six cases out of 583. This is an incidence of 7.8 per cent. Hurt and Broders[3] found seventy-one cases of multiple malignant tumors in 2,124 cases of malignancy, an incidence of 3.3 per cent.

The two cases reported here are not published because we think of them as rarities, but rather because we believe that many similar cases will be found if clinicians are made aware of their frequent occurrence. It is perfectly natural for the examiner to be satisfied with the diagnosis of carcinoma with metastases, and from then on all clinical signs are explained by the primary diagnosis. However, if the examiner is thorough and keeps on investigating he will find that in a fair number of cases he will discover an additional lesion, quite possibly a malignant one, which he did not expect to find originally.

In our first case the diagnosis, carcinoma of stomach with metastases, was made early. Later when symptoms developed which did not fit the diagnosis, further examination disclosed the presence of a prostatic carcinoma which also had metastasized.

In the second case, prostatic carcinoma with metastases, was the primary diagnosis, but when rectal spasm became an outstanding complaint, further examination disclosed the presence of a rectal tumor which did not arise from the prostate.

CASE REPORTS

CASE 1. The first case is that of an adult, white male, sixty-four years of age, who was admitted to the hospital on January 12, 1941. His complaints were pain in the right thigh and leg, pain over the chest and back, cough, weakness, some fever for the past six months, and epigastric pain following meals. The pain in the leg could be relieved only by opiates.

His past history was not significant. He had a hemorrhoidectomy in 1912. In his family history he stated that his father died of carcinoma of the stomach at the age of sixty-four, and one brother died of carcinoma of the stomach at the age of fifty-six.

He was a sixty-four year old white male, intelligent and well oriented. He appeared chronically ill. He had a good physique, but it was apparent that he had lost considerable weight. There was marked pallor of the skin, mucous membranes, and nail beds. The skin had a lemon-yellow tint with diminished turgor due to loss of subcutaneous fat. His head, eyes, ears, nose, and throat were normal. His thyroid appeared normal. There was no evidence of organic heart disease. Blood pressure was 130/70. A few sibilant râles were heard over the lung bases. Ribs appeared and felt normal, but marked tenderness was present over his sternum. His abdomen was entirely negative; no masses were felt. The liver and spleen were not enlarged. On rectal examination there was a moderate enlargement of both lateral lobes of the prostate. In the left lobe, at its upper margin, a hard nodule was palpable. There was tenderness over his right thigh and leg; there was no edema of the lower extremities.

Just after admission, the patient had a severe hematemesis, and for a long time thereafter had occult blood in his stools. Gastric analysis revealed a complete absence of free

hydrochloric acid. Although no filling defect of the stomach was demonstrable on x-ray, a definite hourglass constriction was seen.
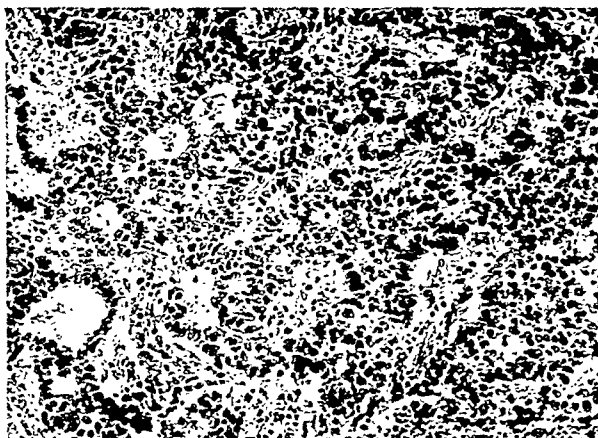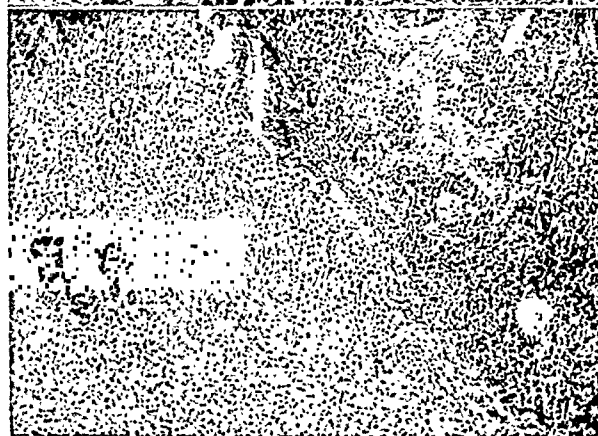

FIG. 1.

FIG. 2.

FIG. 1. Case 1. Adenocarcinoma of stomach.
FIG. 2. Case 1. Metastatic tumor in liver.

Numerous blood counts showed a very severe anemia, the red cells being approximately a million with numerous hemoglobin readings that varied between 24 and 28 per cent. The hematemesis, occult blood in the stool, x-ray findings of hourglass constriction of the stomach, and the severe anemia, plus the achlorhydria, made a definite picture of carcinoma of the stomach.

Examination of his bony structures by the roentgen ray revealed metastatic lesions of the skull, ribs, spine, pelvis, and femora. Because of the rarity of metastasis to these bones from a primary carcinoma of the stomach, it was believed that the nodule in the prostate was also a primary malignancy.

A sternal bone marrow biopsy revealed that the normal architecture of this bone was completely replaced by metastatic malignant cells.

The patient slowly lost ground and died on May 15, 1941.

A complete autopsy was performed. The findings were: adenocarcinoma of the stomach with gastrointestinal hemorrhage and with a metastatic nodule in the liver; adenocarcinoma of the prostate with metastases to the sternum, pelvis, femora, and ribs.

Histological studies showed one carcinoma of gastric origin with hepatic metastasis, and another prostatic in origin with bone marrow metastasis. The former was characterized by the occurrence of acini lined by columnar type of epithelium, large vesicular nuclei containing prominent nucleoli. Its origin could be traced from gastric mucosa in several places which showed a marked degree of anaplastic changes.

The prostatic carcinoma was of the medullary type, and was composed of large groups of polyhedral cells with vesicular and densely pyknotic nuclei. There were attempts of acinar formation.

The bone metastases showed morphological characteristics similar to the neoplasm as seen in the prostate. (Figs. 1, 2, 3 and 4.)

spine did not show any metastases. An intravenous pyelogram showed normal kidneys and ureters. The blood chemistry findings were
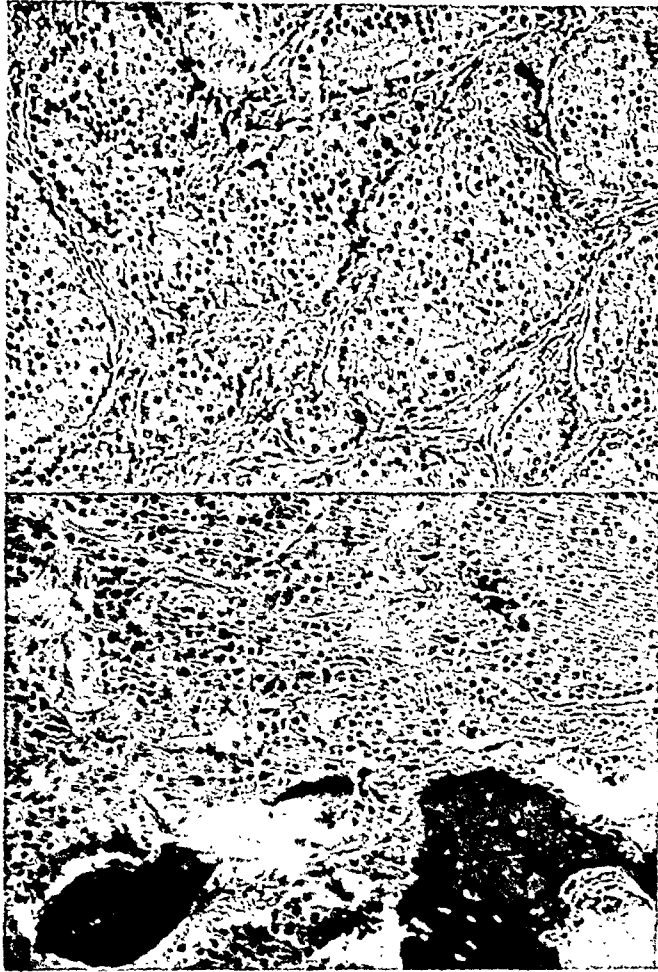
FIG. 3.

FIG. 4.

FIG. 3. Case 1. Adenocarcinoma of prostate.
FIG. 4. Case 1. Metastatic tumor of sternum.

CASE II. The second case is that of a sixty-two year old male who was admitted for the first time in April, 1941. The one significant fact in his past history was an incomplete suprapubic prostatectomy in 1937, at another hospital, which resulted in a vesicorectal fistula. This persisted for six months. At the time of his admission he suffered from urinary frequency and dysuria. The residual urine measured 650 cc. Cystoscopy showed an irregular bladder neck, an inelastic prostatic urethra, and nobbins of white tumor tissue growing into the lumen of the urethra and beneath the mucosa of the bladder neck. The rectal examination revealed a large flat, fixed mass of wooden hardness which extended beyond the reach of the examining finger. A roentgen plate of the pelvis and the lumbar

normal. Diagnosis: carcinoma of the prostate. A suprapubic cystostomy was made, at which time the tumor tissue at the neck of the bladder could be seen and felt. The patient did poorly. Two months later he developed pain in the left leg which was temporarily relieved by two intradural injections of alcohol.

In October he had become bedridden. He had continuous pain in both legs, both shoulders and in the neck. A roentgen plate of the pelvis showed a large dense lesion involving the entire right ala of the ilium. There were also lesions of the sacrum, of the left ilium, of the right pubic, and of the right ischial bone. The fifth lumbar vertebra showed an increased density. The plate of the cervical spine showed osteolytic and osteoplastic lesions of the fourth, fifth, and sixth cervical vertebrae, most marked

in the fifth. The rectal examination showed again the large, fixed, mass of wooden hardness in the region of the prostate. On October 20th

through the suprapubic opening and also per rectum. He died on January 27, 1942.

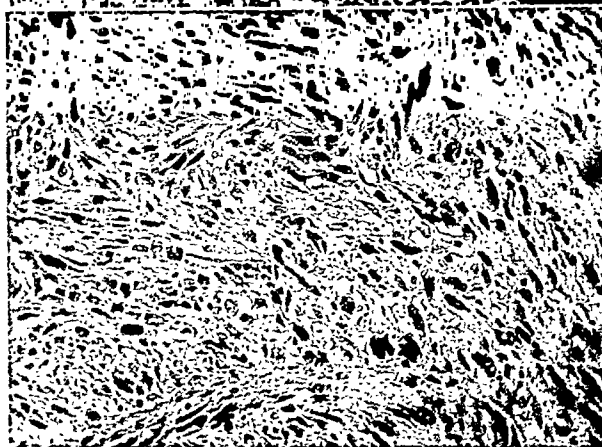Only a limited autopsy permission could be

FIG. 5.

FIG. 6.

FIG. 5. Case 11. Carcinoma of prostate.
FIG. 6. Case 11. Rhabdomyosarcoma of bladder.

a bilateral orchidectomy was done which resulted in a startling improvement of the patient's condition. Five days after the operation he was able to walk, he could move his head freely, and he had hardly any pain.

However, six weeks after the operation he developed severe spasms of the rectum with bloody stools. A rectal examination at this time showed a diminution of the prostatic mass, which, however, was still very hard and fixed. Above the prostate a very soft, fungating, and pedunculated tumor could be felt. On December 10th this tumor mass was removed by blunt dissection after dilating the anus. The histological diagnosis of the tissue removed was sarcoma.

The patient rapidly lost ground from then on. Necrotic tissue masses were expelled

obtained, allowing the removal of the bladder and the rectum. The bladder contained a soft, pedunculated, partly necrotic tumor which arose from the trigone. The tumor had grown through the vesicorectal fistula into the rectum where it also formed a soft, pedunculated, partly necrotic tumor mass measuring about 10 cm. in diameter. The prostate was hard, but not markedly enlarged.

The histological examination of the soft tumor showed it to consist of spindle-shaped cells containing large ovoid nuclei with large prominent nucleoli. There were numerous mitotic figures and few multinucleated tumor cells. Fine striations could be seen in the cytoplasm of some of the larger cells. Diagnosis: rhabdomyosarcoma.

The sections of the prostate showed irregular proliferating acini lined by high cuboidal epithelium with rounded vesicular nuclei. Some nuclei though were densely pyknotic. In other places acanthomatous plaques of polyhedral cells with abundant cytoplasm and large prominent nuclei were found. Diagnosis: carcinoma of prostate. (Figs. 5 and 6.)

SUMMARY

1. Attention is drawn to the relative frequency of multiple malignant tumors.

2. Two cases are presented, one with two carcinomas, both of which metastasized, and one with a carcinoma and a sarcoma.

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AFTER abdominal operations of a major character, only the subcutaneous and the intravenous routes are to be depended upon for the administration of fluid. In the main, unless the rate of flow is adjusted carefully, it is better to give saline solution, or 5 per cent solutions of glucose under the skin. The too rapid intravenous administration of fluid is hazardous, especially in poor risk patients.

MANGLE BURN INJURIES

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MUCH literature in the present day medical journals has to do with the treatment of burns. I want to

dorsum of the right hand, fingers, forehand and four inches up above elbow, in a hot mangle which the mother left running while

FIG. 1. Photograph taken six months after burn.

present here a rather infrequent type of burn, i.e., compression burn, from an iron mangle, by presenting a case in which the patient was treated with sulfathiazole ointment followed by three types of skin grafting. The functional result was good. The cosmetic results will improve with the age of the child and further plastic procedures if necessary.

CASE REPORT

On May 28, 1942, a four-year old female child was brought to the hospital approximately one-half hour after sustaining a second and third degree compression burn on the

she answered the telephone. The child was in mild shock. Morphine sulfate gr. ⅙ was administered. X-ray revealed no fractures. The skin of the hand not burned was scrubbed with green soap and followed by white merthiolate solution. The hand was then wrapped in dressings saturated with 5 per cent sulfathiazole ointment. In three weeks a good clean granulating surface was present.

On June 19th, under general anesthesia, the hand, including the knuckles and wrist joint, was placed in a double slit pocket in the skin of the abdomen for a full thickness graft. A few nylon 4° interrupted stitches were used to hold the graft closely to the hand. Thiersch grafts were placed on the dorsum of fingers, and multiple pinch grafts were used above the

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wrist. These grafts were held in place by paraffin mesh gauze; then a torso cast was applied to hold the arm in position for graft healing.

The patient developed a temperature of 102° and 103°F. on the third day, postoperatively. Sulfathiazole by mouth was given. The fever remained around 101°F. until a window in the cast over the hand was removed and the abdomen under the graft irrigated with half strength hydrogen peroxide containing 1 Gm. of sulfathiazole powder. The temperature elevation was due to inadequate drainage beneath the palm.

Two weeks after the original operation the full thickness graft was cut free. This graft was well fixed to the dorsum of hand and wrist. The Thiersch grafts had taken well on fingers, and most of the pinch grafts. Two weeks later pinch grafts were put on the granulating surface on the abdomen. After curetting the granulation remaining on the forearm, additional pinch grafts were placed on the forearm.

On August 21st, the patient was discharged with a very good functional result. I believe with care of this new skin by a mild cod liver ointment, cosmetic results will be good by the time she is a young lady, without additional plastics which could be done. One x-ray therapy treatment was used to prevent keloid formation.
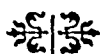
A BETTER knowledge of the effects of obstruction; a more acute appreciation of the criteria which permit timely recognition of the presence and identification of the type of obstruction; and, finally, a more discerning understanding of the limitations and virtues of the available remedial agents, together with a keener interest in the technique of carrying out therapeutic precepts with precision—these are the important items in the bowel obstruction problem.

The brief excerpts in this issue have been taken from "Intestinal Obstructions" by Owen H. Wangensteen, Second Edition (Charles C. Thomas).

PNEUMOCOCCIC MENINGITIS AND ENDOCARDITIS FOLLOWING FRACTURE OF THE SKULL*

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ACUTE pneumococcic endocarditis is conceded to be a rare and fatal complication of pneumococcemia. However, its rarity may be dispelled if an attempt is made to establish the diagnosis. According to Ruegsegger[1] the diagnosis should be made in 50 per cent of the cases provided suitable laboratory facilities are available. The following case is reported because of its unusual clinical course and necropsy findings:

CASE REPORTS

B. V. S., a forty-five year old white male, was admitted to Morrisania City Hospital on October 9, 1941, after having been picked up in the street. He had no recollection of what had happened in the twelve hours preceding admission except that he had been "drinking." His family history was noncontributory. It was noted in his past history that the patient had been confined to bed for many weeks because of rheumatic fever at twenty-three years of age. "Drinking bouts" had increased in frequency during the past few years. For the past year he had suffered from repeated attacks of "neuritis." In the few days prior to the present episode he had a "head cold."

On admission to the hospital he presented the picture of a well developed, well nourished white male, acutely ill with a distinct alcoholic odor to his breath. There was a laceration over his left eye. Both pupils were equal in size, regular, and reacted to light and accommodation. Old and fresh blood oozed from both nares. Both lungs were clear to palpation, percussion and auscultation. The heart was enlarged to the left. The point of maximum impulse was in the sixth intercostal space outside the midclavicular line. There was a harsh systolic murmur at the apex transmitted to the axillary region. A low pitched diastolic blow was also heard over the apex. Over the aortic area a systolic murmur associated with a systolic thrill was elicited. Examination of the abdomen and extremities revealed no positive findings. Neurological examination revealed no impairment of the cranial nerves. Abdominal reflexes were present on the right and absent on the left. Biceps, pectoral, knee jerks, ankle jerks were active, particularly on the left. Kernig and Brudzinski signs were negative. Babinski was negative on the right, suggestive on the left. There was no nuchal rigidity. Sensation and muscular power were good. Admission temperature was 101°F., pulse 96, respirations 22. Laboratory findings were: Hemoglobin 85 per cent; red blood cells 4,100,-000; white blood cells 21,000 with 78 per cent polymorphonuclears, 14 per cent transitionals and 8 per cent lymphocytes. Urinalysis was negative. The impression on admission was: (1) Craniocerebral trauma—concussion and possible fracture of the skull; (2) rheumatic heart disease (inactive); (3) acute alcoholism.

During the first hospital day the temperature rose to 102°F. and on the second day to 104.8°F. At this time the patient developed a productive cough and the sputum was streaked with blood. Examination of the sputum revealed pneumococcus type VII. Diminished breath sounds were heard over the left chest posteriorly. X-ray of the chest was negative. The blood count showed white blood cells 23,000 with 82 per cent polymorphonuclears. The urine was negative. He was placed on sulfapyridine therapy on the second day, receiving 90 gr. per day. Temperature dropped on the third day to 101.4°F. and on the fourth day after touching 102°F. at twelve o'clock noon, it dropped to normal.

On the third day he had developed signs of meningeal irritation, viz., stiff neck, bilateral Kernig's, weakness of his right upper extremity with a suggestive wrist drop. He was confused, disoriented and very restless. The impression at this time was probable subarachnoid hemorrhage and a right brachial plexus lesion. Spinal

tap done at this time revealed a faintly xanthrochromic fluid with an initial pressure of 130 mm., 1,200 red blood cells, and only

ally sank into a deep coma and died on the morning of the eighth day. The final clinical impression was: (1) Possible fracture of the

FIG. 1. Pneumococcic meningitis; plastic exudate covering cerebral hemisphere.

an occasional white blood cell was present. Sugar was negative and Pandy was positive. Smear revealed many Gram-positive diplococci which were identified as pneumococci type VII with Neufeld typing. Culture of the same fluid twenty-four hours later was also positive for the same organisms. The presence of a pneumococcic meningitis was now confirmed, probably secondary to a basilar fracture of the skull and pneumonia, despite absence of x-ray evidence (which was deferred, owing to the critical condition of the patient). A blood culture taken at this time showed contamination and was discounted.

On the fourth day the patient still seemed drowsy but his restlessness had diminished. On the fifth day spinal tap revealed 150 cells (mostly red blood cells) with some white blood cells, and pneumococci were present on direct smear. Sugar was negative, total protein 236 mg. per cent. Blood sulfapyridine at this time was 9.1 mg. per cent. His temperature fell to 99°F., highest level this day was 100.6°F. He appeared clinically improved, but that night he became irrational and extremely noisy. He was given large doses of phenobarbital. The weakness of his right upper extremity seemed to be extending to his right lower extremity.

On the sixth day his temperature rose to 104°F. from the previous level of 100.6°F. On this day his spinal fluid showed 270 red blood cells and some white blood cells. There was dullness at the right base with moist râles. His condition became very poor and he gradu-

skull; (2) pneumococcic type VII meningitis; (3) pneumococcic pneumonia type VII.

The essential findings post-mortem were as follows:*

Brain. Small area of hemorrhage in the left occipital region of galea. The brain weighed 1400 Gr. The vessels were markedly congested; there were many areas of greenish-yellow accumulations 2 to 3.5 cm. in diameter within the subarachnoid space clearly evident over the entire cortex of the brain, particularly over the left cerebral hemisphere. A plastic exudate covered the base of the brain, more especially the ventral surface of the pons, medulla and cerebral peduncles. There was some flattening of the convolutions on the left side. Punctate hemorrhages were noted throughout the brain ranging from pin-point to one-eighth inch in diameter. There was a branching linear fracture beginning in the left frontal bone and running downward traversing the left anterior fossa. A small amount of epidural hemorrhage was evident at the fracture site.

Heart. The pericardial sac contained 25 cc. of straw colored fluid. The right auricle and ventricle were normal. The right A-V orifice admitted two and one-half fingers. The A-V and pulmonic cusps were thin, smooth and glistening. There was no atherosclerosis of the pulmonary artery. The left auricle was slightly dilated. The left ventricle was moderately

hypertrophied. The mitral orifice was stenosed admitting only one finger. The mitral cusps were thickened, with marked fusion of the

prising bacterial clumps were also evident and under the oil immersion lens Gram-positive diplococci could be seen. The cardiac muscula-

FIG. 2. Pneumococcic endocarditis with friable vegetations involving the aortic cusps and adjacent muscle.

commissures, and shortening of the chordae tendinae. The aortic cusps were thickened and contained a large amount of calcific deposits. In the region of these deposits there were ulcerations to which were attached polypoid friable vegetations. These vegetations involved the right anterior and posterior cusps. There was a thrombus of friable material in the right posterior Sinus of Valsalva. The coronary ostiae were patent. The coronaries were moderately sclerosed. The myocardium on cut section presented small areas of greyish white tissue which had all the appearance of necrosis. There was moderate atherosclerosis of the aorta.

Lungs. Both pleural cavities contained no free fluid. The pleurae were thin, smooth and glistening. Both lungs were crepitant throughout and on cut section presented a normal architecture. Except for some congestion at the left base, there was no hilus adenopathy. The mucous membrane lining trachea and bronchi was slightly congested.

Microscopic. Right posterior aortic cusp and adjacent muscle: the cusp was markedly thickened and fibrosed. The connective tissue showed a great deal of hyaline degenerative change. On the aortic aspect there were numerous bluish areas of calcific deposits. The cusp was diffusely infiltrated with a superabundance of polymorphonuclear, lymphocytic and plasma cells. Small irregular bluish staining areas com-

ture immediately adjacent to the cusp showed separation and fragmentation of the muscle fibers, their nuclei in various phases of degeneration. The interstitium between the fibers was infiltrated to a marked degree with polymorphonuclear and lymphocytic cells.

Brain. The subarachnoid space was distended and filled with a great many polymorphonuclear lymphocytic cells, and with an occasional macrophage. Bacterial clumps were also evident. Vessels were distended and congested. The cells of the cortex showed evidence of rarefaction, falling out of ganglion cells with neuronophagia and generalized degenerative changes of the ganglion cells throughout the cerebrum and cerebellum.

Anatomical Diagnosis: (1) Fracture of the skull; (2) pneumococcic meningitis Type VII; (3) pneumococcic endocarditis superimposed on an old rheumatic heart valvulitis.

REMARKS

With the advent of chemotherapy meningitis is not considered as hopeless as it was formerly. In a survey of the literature one is noticeably confronted with the increasing frequency of reports of cures in meningitis, more especially since the introduction of sulfapyridine by Whitby[2] in 1938. Goldstein and Goldstein,[3] in a review of the literature, cite recoveries from pneumo-

coccic meningitis as well as recoveries even from nonpurulent meningitis reported in the past ten to fifteen years. They urge a more energetic and enthusiastic approach to these cases which in the past were considered in such an unfortunate light.

In the case reported the meningitis appeared at one time during the course of illness to be responding to sulfapyridine therapy. This is evidenced by the marked drop in temperature, the clinical improvement, and the diminution of cellular elements in the spinal fluid. The postmortem findings of an acute vegetative pneumococcic endocarditis superimposed on a previously injured valve readily explain, however, the patient's demise. This is in support of the observations that have been reported as to the relative amenability of meningitis to chemotherapy contrasted with the marked resistance of a bacterial implantation on the cusps of heart valves. Terry and Beard,[4] of the Cleveland City Hospital, reported a case of pneumococcic meningitis and endocarditis, proved clinically by positive signs and positive laboratory findings both in spinal fluid and blood, treated with sulfapyridine. In spite of the complete clearing of the spinal fluid the patient expired. At postmortem the meninges showed no pathological changes except for a slight increase in the collagenous tissue. The cusps of the aortic and mitral valves, however, showed fresh vegetative endocarditis. Thornton Scott[5] reported a case in which definite evidence of meningitis was present during life with numerous type II pneumococci on direct smears and culture of the spinal fluid. Yet, following massive doses of sulfapyridine, there was no evidence of active meningitis postmortem. The cause of death was an acute vegetative endocarditis.

The marked resistance of organisms implanted in the cusps of the valves to chemotherapy is borne out by the observations of Ruegsegger[1] who was able to recover viable organisms from pneumococci vegetation immersed twenty-two months in formalin.

The organisms are embedded in such a dense protective meshwork of fibrin, platelets and cells that they become relatively immune to destruction.

In the case reported in addition to the presence of endocarditis, microscopic examination of the myocardium revealed definite evidence of a suppurative process. The existence of such a lesion is indicative of a fulminating course which would prove fatal. Involvement of the myocardium has been reported in association with endocardial lesions by Rhodes, McMahon and Burkhardt, Ginga and Bouche,[6] and in isolated form by Luphin, Westenhoppe, Glion, Balke, Klemperer.[7] The pathological lesion in the above case report is similar to those cited.

This case has been reported to substantiate many of the observations that have been made regarding the successful treatment of the purulent meningitis with chemotherapeutic drugs in contrast to the poor results obtained in cases of purulent endocarditis. In the event that the meningitis shows no signs of clearing, other foci of infection should be looked for.

SUMMARY

In this report, we have seen a fracture of the skull which was followed by pneumococcic pneumonia type VII and meningitis. Although the meningitis improved upon sulfapyridine therapy, the patient succumbed to a pneumococcic type VII endocarditis superimposed on an old rheumatic heart lesion which was demonstrated upon autopsy.

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GANGRENOUS APPENDICITIS IN FEMORAL HERNIA OF RICHTER'S TYPE*

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THE unusual occurrence of a gangrenous appendix found in a strangulated femoral hernia sac of Richter's type, which was operated upon three days after strangulation, induced the following report, and review of the pertinent literature.

CASE REPORT

Mrs. P. M., a forty-eight year old woman, was admitted September 8, 1942, with a history of severe pain in the right groin, of three days' duration. She had noted a "lump" in the right groin for about ten years, but it had disappeared three years later with her first and only pregnancy. During the past week the mass reappeared and became larger. Three days previous to operation she noted a sudden increase in the size of the tumor, associated with severe urinary urgency and frequency. She had been nauseated for about ten hours but vomited only once in a deliberate effort to relieve her distress.

Physical examination revealed essentially normal findings in all organs except for a reddened and painful tumor, the size of an egg, in the right inguinal region. The temperature was 102.4°F. with a pulse rate of 110 and a blood pressure of 106/82. A diagnosis of strangulated femoral hernia was made.

At operation under spinal anesthesia the hernial sac was located medially to the femoral vessels. The sac was filled with a foul purulent fluid and contained a ruptured and gangrenous appendix together with gangrenous portions of the omentum and part of the cecum. The appendix was removed, the gangrenous omentum was resected, and a cecostomy was done without attempt to reduce the hernial sac. The adhesions around the femoral opening were left undisturbed to prevent generalized peritonitis. About 8 Gm. of sulfanilamide were placed into the wound which was left open for free drainage.

Postoperative treatment consisted of venoclyses of 1,000 cc. of 5 per cent glucose in normal saline every eight hours for forty-eight hours, nothing by mouth, and control of abdominal distention by a Wangensteen apparatus. About seventeen days after operation the cecostomy was closed by inversion and the cecum retracted into the abdomen. The femoral wound was then closed by simple silkworm sutures. After an uneventful recovery the patient was discharged in good condition one month after admission.

REMARKS

Partial or Richter's hernia is a strangulated hernia in which only one wall of the intestines is constricted and strangulated. It is generally stated that Fabricius Hildanus observed the first case in 1598. However, his report is open to criticism because he did not see the actual anatomical relationships. His patient, a sixty-three year old woman, had a hernia of the groin for seventeen years. It became strangulated and was reduced *en masse*. Gangrene developed and led to a fecal fistula which closed spontaneously two months later. Hildanus never saw the bowel in the hernial sac, but simply believed that it formed a partial hernia because of the subsequent development of the fecal fistula.

Lavater, in 1672, was the first to describe it anatomically. A similar hernia containing the appendix was then described in 1731 by de Garengeot, who misdiagnosed it as an inguinal abscess but at operation found the gangrenous and suppurating appendix in it. In 1778, Richter published his detailed studies of partial hernias, and from then on his name has been identified with this type of partial enterocele. However, such eponyms as Lavater's hernia and wrongly also

Littré's hernia are synonymous with it. Since Richter's hernia resembles a diverticulum, it induced Littré to describe his two cases of Meckel's diverticula as partial intestinal enteroceles. Cattell, in 1933, could find records of only fourteen Richter hernias which had come to operation between 1899 and 1933. The average age of the patients was forty-eight years.

Watson, in 1938, found a total of 537 cases of hernias containing the appendix, and 222, or 40 per cent, of these were of the femoral variety. To these should be added seven additional reports of femoral hernias containing the appendix, bringing the total to approximately 229 appendices in femoral, and to about 545 in all varieties of hernias. Not included in these figures are five cases from the foreign literature: four Italian and one Russian, reported since 1939, since the references could not be verified in the original.

Richter hernias become more frequently gangrenous than any other type of strangulated hernia, probably due to the direct pressure of the constricting ring, and because of the absence of the cushioning mesentery from the hernial sac. Symptomatically, the findings are not typical since some volume of feces and gas can still pass the partial constriction of the gut and thus generally prevent distention. Treves believed that less than 50 per cent of all femoral or inguinal strangulations show swelling or tumor formation, and that local tenderness or pain may be so slight as to pass unnoticed by the patient for several days until gangrene develops. This was also true in our patient who delayed admission for three days. Often the strangulation may suggest inguinal or femoral lymphadenitis especially when the moderate fever and pain of early gangrene sets in,—a complication which ensues rapidly and leads to an unfavorable prognosis because operative intervention is often too late. The mortality rate of Richter's hernia is, therefore, much higher than that of ordinary strangulated hernias.

Femoral hernias of Richter's type predominate in females and on the right side. According to Berger femoral hernias per se form 32.7 per cent of all hernias in females, but only 5.6 per cent in males.

The site of herniation is usually between the femoral vein and the lacunar ligament of Gimbernat. Hernias below the inguinal ligament of Poupart and external to the femoral vessels are rather rare. Once the hernial sac has passed through the saphenous opening into the thigh it may reflect back over the inguinal ligament and suggest an inguinal hernia. The hernial sac may contain any one, or several, of the abdominal viscera, and the sharp edges of the lacunar ligament of Gimbernat is usually the point of strangulation.

As early as 1804, Sir Astley Cooper pointed out that femoral hernias may disappear during pregnancy, not to recur until some time after parturition. This observation was also made in our patient whose hernia had disappeared seven years previously during her only pregnancy, and recurred only some time postpartum.

In Watson's monograph it is stated that 40 per cent of all femoral hernias contained the appendix, while in all other types of hernias the incidence is only 1.5 to 1.0 per cent. As far as can be ascertained only 194 of the 230 patients who presented an appendix in the femoral hernia sac were operated upon. By sex distribution 185 were women and only nine were men. Doolin's patient, cited by Seley as a man, was actually a woman. Appendectomy was performed 149 times with the death of five patients, or a 4 per cent mortality. In twenty-three instances the appendix was reduced through the hernial orifice, and two patients, or 10 per cent died. In the other twenty-two patients the gangrenous and suppurating hernial sac was merely incised and drained, and nine patients, or 40 per cent, died. These figures indicate appendectomy as the procedure of choice in the treatment of this condition, to be followed subsequently by drainage, colostomy and hernial repair as deemed necessary, since it offers the best prognosis and

has the lowest mortality as well as also the least complications.

SUMMARY

Strangulated appendix occurs simultaneously with 40 per cent of all femoral hernias. To date approximately 230 cases have been reported, including a personal observation. This condition predominates in women, since only nine males are reported. Primary appendectomy is the operation of choice. The mortality of other operative procedures is discussed. Richter's type of hernia is unusual and its contents become gangrenous more rapidly than in any other type of hernia because of the absence of the mesentery. The symptomatology is atypical and not pathognomonic.

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Editorial

POSTWAR MEDICAL ECONOMIC PROBLEMS

THE world conflagration is entering a phase in which postwar planning begins to assume an ever greater importance. Our national administration anticipates serious dislocations in the social structure of our country after the victorious conclusion of the war. Plans are being prepared which may absorb the inevitable shock to our well established peace standards. There can be but little doubt, that the worldwide clash of opposing ideologies will eventually lead to profound changes in our present national life. It is of great importance that the medical profession be prepared for the essential rôle it will have to play in the postwar social adjustments.

In the past, organized medicine had as its outstanding achievement the protection of the great public, by establishing and maintaining a high ethical and professional standard in medical care. This accomplishment was made possible by the wholehearted and unselfish co-operation of the entire medical profession.

During the economic stress of the prewar period, however, a large minority of our professional membership began to view with growing apprehension the apparent inability of our medical administration to cope successfully with the grave economic problems that have arisen within the public as well as within our own ranks. In the past decade, our Government em-

barked on a well planned experimentation to eliminate certain social injustices relating to non-medical fields. The impression, that organized medicine's stand in these critical times was neither forceful nor constructive, was the cause of unrest within our professional body.

At the present time, the medical profession is giving further evidence of unselfish co-operation, by taking its part in the war effort. Medical practices, which were built up with so much sweat and toil, are being voluntarily given up by those who enter the Armed forces.

After the war, due to his prolonged absence from civilian life, the physician returning from the war front is bound to find increasing difficulties when resuming his practice. It is the great responsibility of those, who remained on the home front, to work out a constructive plan which will spare our homecoming medical men from undue hardships. The failure of effective postwar planning now will adversely affect the public health and also our professional standards. Medical care dispensed by weary, disillusioned men, is not likely to be of the high plane to which our public became accustomed in the past, and, on the other hand, an unbearable economic plight among our medical men may easily lead to a deterioration of the high ethical standards of our profession.

In the postwar planning of medical care, due consideration should be given to the economic problems of the medical profession. Up to the present time, in the discussions of adequate medical care to the "underprivileged" classes, not much thought was given to the adequate compensation for our medical services. The community looks upon physicians as being individuals of a prosperous, financially self-sufficient class. The lavish dispensation of free medical services seemingly supports this general assumption. Individual physicians intentionally contribute to this false conception by keeping up outward appearances which do not reflect their true economic status. As a matter of fact, the economic condition of the medical profession underwent a steady deterioration in the past decade, and in a large group it sank below subsistence levels. This group's subsistence largely depends upon the material support given by wives, parents and other close relatives. The end of this process is not yet in sight.

The general public is not aware of the medical profession's economic difficulties. It may expect, therefore, further sacrifices from us in the form of extended free medical services. It is probable that our Government is now preparing a sweeping reform of our present medical care. For such an eventuality, we should be ready with a plan, which gives us full protection with just appreciation of our economic needs.

Unless organized medicine is capable and willing to act constructively now, we are faced with the probability, that after the war, a majority of our professional membership will welcome a government plan of health care as part of the general social security system.

It is regrettable, that an open discussion of our economic problems is not possible, since organized medicine suspended its meetings for the duration of the war. We must, therefore, rely on the vision and wisdom of our medical leaders to bring about a satisfactory solution of our postwar problems. Let us hope, that after the storm of social adjustments has blown over, organized medicine will not have to pride itself with having been the last bastion of dye-hard conservatism in a changing world.

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TECHNIC OF PODALIC VERSION AND EXTRACTION

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JUST as the attitude toward early cesarean section and the avoidance of long drawn out tests of labor has changed, so has the attitude in the past ten years changed toward the use of version and extraction. The profession now believes that the technic of this type of delivery should be part of the armentarium of everyone who professes to practice obstetrics. He at least should have a working knowledge of the fundamental principles and maneuvers involved in this type of mechanism of labor.

The indications for this procedure vary with the individual skill of the operators. Some men elect this method of delivery as a routine method of eliminating the second stage of labor while others reserve this procedure for persistent posterior position of the fetal head, deep transverse arrest of the head, uterine inertia, floating heads, etc. Regardless of the indications certain essential prerequisites must be kept in mind if a successful result for mother and child is to be obtained.

In a recent publication[1] we emphasized the fact that a version and extraction should not be attempted until the lower uterine segment is thinned out and the external os completely dilated. The failure to observe this fundamental fact in any type of vaginal delivery has caused untold calamity.

The diagrams labelled 1 and 2 demonstrate in a schematic way, conditions (Figs. 1, 2 and 3) of the lower uterine segment and external os, which are unfavorable for a version and extraction. It will be noted that in both drawings there is still a remnant of the internal os and that the external os is thick. In other words, the effacement of the lower uterine segment and the dilatation of the external os is not complete and is, therefore, not in an ideal condition for attempted delivery.

Figure 3 represents the ideal condition of the lower uterine segment and the external os. The lower uterine segment has been thinned out, the internal os has disappeared and the external os is completely dilated. When those conditions are present the ideal time has arrived for the performance of version and extraction.

Another essential fact to be remembered is that a version should never be attempted when the uterus is dry and firmly contracted around the fetus. This condition does not exist as a rule excepting after ruptured membranes and a long labor. The uterus has molded itself around the fetus and a very definite retraction ring is present. (Fig. 4.) Any attempt to perform a version under these circumstances is, to say the least, poor obstetrical judgment and can result only in a ruptured uterus.

A third precautionary fact to be kept in mind is that, while a floating head can be delivered by this procedure, this type of case always carried a greater risk, and the operator must expect a higher fetal mortality rate, as he does with a breech extraction, because, there is no molding of the

head with flexion. We consider at least partial molding of the head with flexion essential.

of the marked depressive effect upon the baby. If any drug is to be used, it should be morphine sulfate in quarter grain doses and
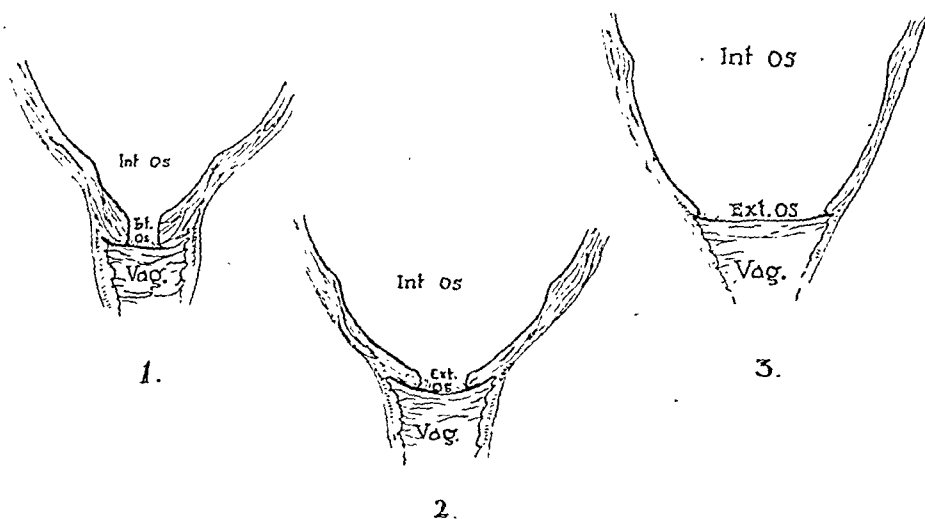
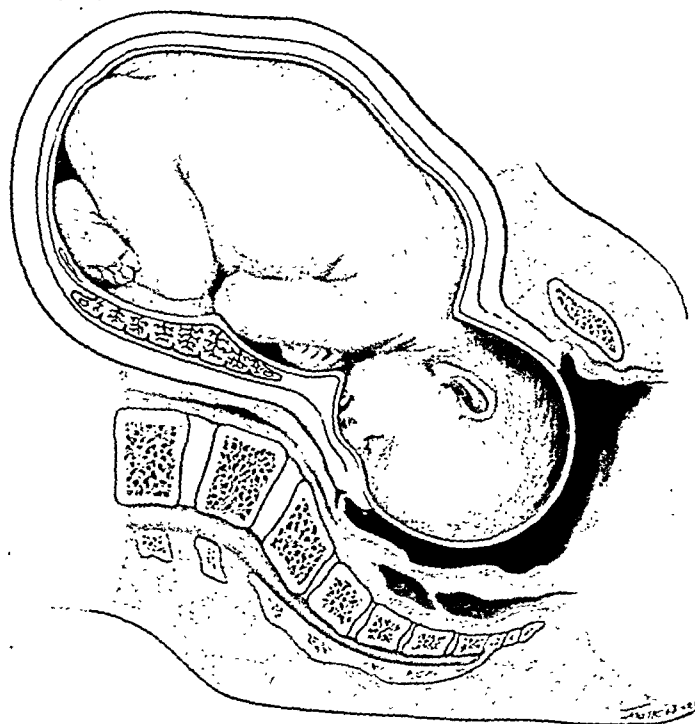Figs. 1 to 3. Various stages of effacement of the lower uterine segment.

Fig. 4. Uterus completely molded around fetus. Impossible condition for performance of internal podalic version.

It has always been our practice to avoid barbiturates of any kind (recent investigations confirm the deliterious effect of these drugs on the fetus) during labor, because

care should be taken not to give it if delivery is to be effected within three hours.

These essential prerequisites are always required before the patient is ready for

delivery by version and extraction: (1) Complete effacement of the lower uterine segment; (2) complete dilatation of the external os; (3) fetal head at or in the brim of the pelvis; (4) membranes unruptured or, if ruptured, the uterus is not too tightly molded about the fetus.

The preparation of the patient consists of cleansing and shaving. No enemas are given because of possible contamination with loose stool.

The patient is draped in the modified Walcher position with nurses holding the legs, and if no assistance is available, the legs can be supported by two chairs whose backs are facing each other.

Chloroform is used as an anesthetic because of its ease of administration and the deep relaxation obtained. Again let us repeat the so-called obstetrical anesthetic has no place in this procedure. The patient must be anesthetized to a surgical degree after which the bladder is emptied by means of a soft rubber catheter.

At this time the vagina is ironed out by the introduction of one finger and finally with the entire hand. The movement is from within out and from above down and is aided by the use of much sterile liquid green soap. When a tight outlet is encountered, twenty minutes is often consumed in this ironing out process. This does away with the need of an episiotomy.

The operator's hand is introduced into the uterus with the palm up in order to more easily follow the curve of the sacrum. The head is grasped like a baseball and is pushed up out of the inlet and iliac fossa.

At this time the position of the head is obtained by paying attention to the ears, which are always on the side of the head and the operator then explores the interior of the uterus and visualizes the exact position of the fetus. It must be remembered, that when the hand and arm, covered with a long rubber glove reaching the elbow, is once introduced into the uterus, it is not withdrawn until the feet are delivered. Repeated introduction of one hand and

then the other is to be deplored because of the possibility of infection.

If the membranes are intact they are separated from the uterine wall, care being taken to avoid the side of the placenta, as detachment of the placenta causes bleeding. They are ruptured high up in order to save some of the amniotic fluid which facilitates the version.

The operator next folds the arms across the chest and under the chin. (Fig. 6.) This maneuver prevents extending of the arms, which is a most serious complication. It is surprising how often the arms are not in the usual textbook position of being folded, but many times are along side of the head or body, and any attempt to do a version before they are folded properly will result in extension of one or both arms and we so firmly believe in this statement, that when the operator does get extension of the arms, he has only himself to blame for he either failed to fold the arms or he did it carelessly. (Fig. 5.)

Both feet are now grasped between the first and middle fingers and brought down as far as the iliac fossa. At this time, it is wise to recheck the folding of the arms and having done this, both feet are brought down to the vulva and delivered together. Continued gentle traction is made until the knees are exposed. The version is now complete.

It is essential to take plenty of time during the following extraction, and the sooner the operator forgets the proved fallacy that a baby must be extracted within seven minutes the better results will be obtained.

Delivery of the buttocks is effected through the hollow of the sacrum by simply lifting both feet up toward the ceiling so that the baby is actually sitting on its mother's perineum.

Whether the original position of the fetus was a right or left sided position will depend upon whether the body will rotate to the patient's right or left spontaneously. Some aid may be needed in the rotation of the body by slight pressure on the baby's
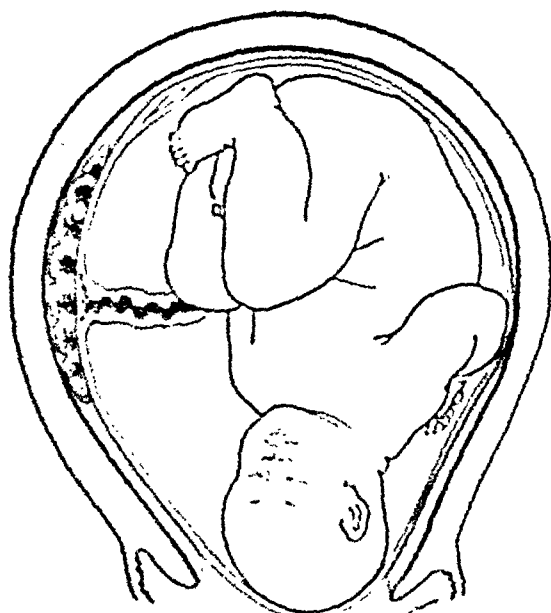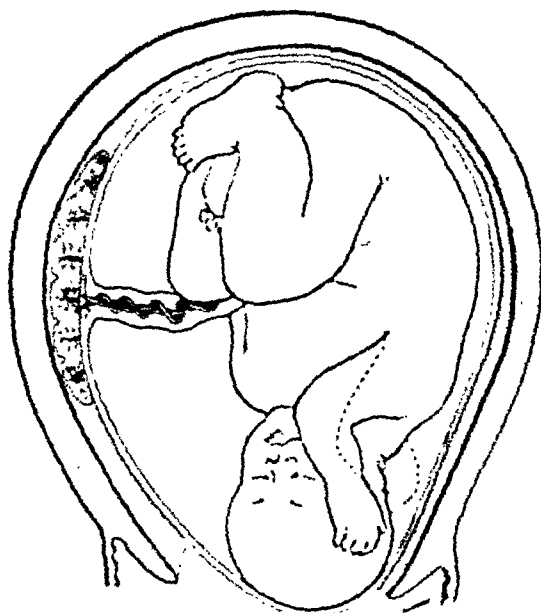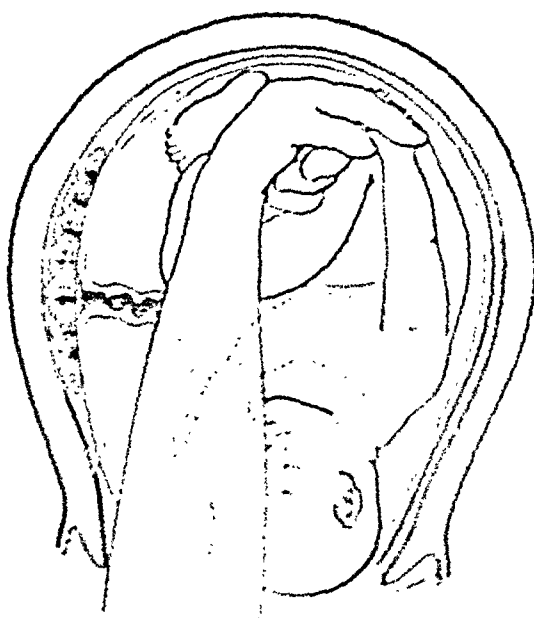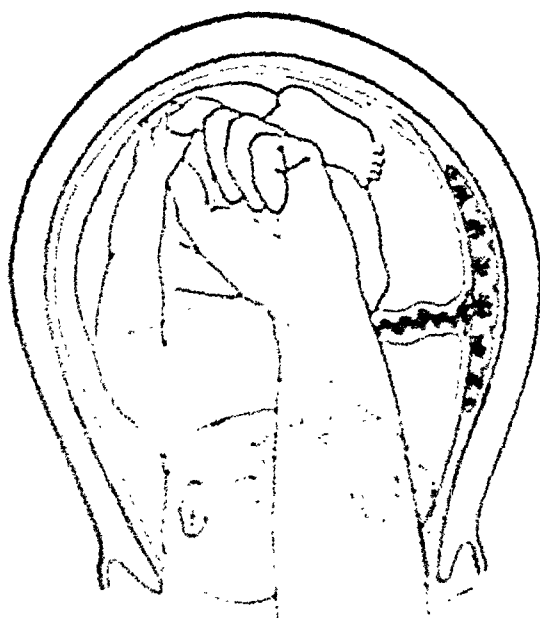
Fig. 58.

Fig. 59.

thigh. The rotation is completed by traction upon both feet in the direction of the mother's thighs until the scapulae appear. Here the aim of the operator is to get the back straight across underneath the pubic arch so as to facilitate delivery of the shoulders and arms as anterior shoulders and arms, doing away entirely with delivery of posterior shoulders and arms. This is accomplished by placing a finger at the angle of either one of the thoroughly exposed scapulae, and with slight pressure toward the midline, deliver the shoulder and humerus. With the finger in the bend of the elbow and avoiding the hooking of a finger around the humerus, the arm is lifted up and delivered in a manner similar to the lifting up of an old fashioned pump handle.

A finger at the angle of the other scapula, after the body has been rotated will convert the posterior shoulder into an anterior one and the extraction is effected as already mentioned. It must be remembered that at no time is the body twisted, but instead by equal traction on both feet, the body will rotate spontaneously.

The operator now determines if there is any loop of cord around the neck or between the legs of the child and if present, this must be eased by cutting it, if necessary.

The fingers of the left hand are placed on the baby's chin or in the mouth and with the right hand gentle pressure is made on the occiput over the pubes, to aid in the flexion of the baby's head and also direct its passage through the pelvic canal.

If difficulty is encountered, forceps, preferably Pipers, are applied to the sides of the head, care being taken not to make application when the head is high in the pelvis. It should be remembered, that it is easier and safer to push a head through the pelvis than to pull it through. (Fig. 9.) When the after-coming head has reached the perineum and the mouth is exposed, the mucous is milked out of the baby's throat and the head gently eased out and lifted up

over the perineal body as a flexed head. The patient must be thoroughly relaxed in the Walcher position to avoid lacerations.
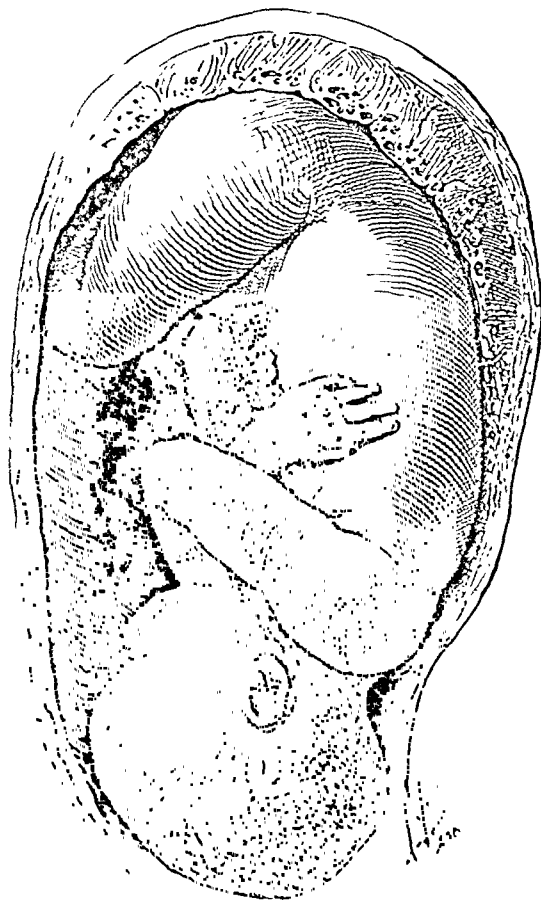

Fig. 6. Proper folding of arms across chest and under chin before attempting internal podalic version.

The baby is placed on its right side on the mother's abdomen, the cord cut, an umbilical clamp applied and the baby transferred to a warm crib.

Following delivery of the placenta, a cubic centimeter of pitocin is given intravenously, the cervix examined and repaired if necessary, the bladder again catheterized and the patient is returned to her room.

COMMENTS

There has been a great deal of discussion concerning the ability of the average general practitioner to carry out this technic. We believe, as we mentioned in the introduction, everyone should know the funda-

mental principles of this type of delivery. We do not believe everyone should try this procedure, but anyone who has had surgical training along with obstetrical training should be qualified to carry out this procedure successfully.

This is not a hospital procedure *per se* as the technic can be carried out in the home with equally good results, as we have often demonstrated.

In our experience in properly selected cases, the fetal and maternal morbidity and mortality is no greater than in other methods of delivery.

This brings up the question of anesthesia. We are firm believers in chloroform properly administered by a competent man, and it behooves any person delivering women to team up with a competent anesthetist at the head of the table. We like chloroform because it is least harmful to the baby, because of its ease of administration, the complete relaxation obtained and the quick recovery of the patient. It must be remembered that the mask must always be the width of two fingers from the face of the patient, and that it takes approximately eight minutes to get a patient in the state of deep surgical anesthesia. The chloroform is not poured but is administered by drops, remembering not to hold the bottle too far from the mask. Fifty per cent of the operator's battle is won at the onset if he has an understanding, co-operative, trained anesthetist. Complete deep anesthesia is needed at only two stages of the procedure, first while the hand and arm are in the uterus, and second, at the time the after-coming head is being lifted off the perineum.

We believe that many lacerations of the perineum are the result of decreasing the anesthesia at this point and the operator's forgetfulness to maintain flexion of the head and pulling the head through the perineal body rather than lifting it up off the perineum.

We have spoken at some length concerning the effacement of the lower uterine seg-

ment and dilatation of the external os because we still find much misunderstanding concerning the proper time to perform this type of delivery. Our discussion on this point is as clear as we are capable of making it. There are, however, isolated cases which require further explanation.

In consultation we frequently see arrest of the head in the midpelvis. The lower uterine segment is effaced, but the head, which is in the transverse or posterior position is above the external os which is perhaps three fingers dilated and will never become more dilated, because of the absence of the head as a dilator at the external os, which is paralyzed, and will become swollen and edematous if delivery is not effected at once. It is surprising how easily under deep anesthesia the external os, represented as a thin negotiable rim, disappears when the examining fingers are spread apart and allows the entrance of the hand into the uterus. As we have stated elsewhere,[1] the crux of the situation is the complete effacement of the lower uterine segment, and dilatation of the external os is one of degree only.

It must also be kept in mind, that the formation of a uterine retraction ring commences at the onset of labor, and that at the beginning of the second stage when the lower uterine segment is completely effaced and the external os completely dilated, the retraction ring is well developed and the longer the second stage the more pronounced is the retraction ring. For this reason alone, we believe that the present tendency of attempting to perform this type of delivery, as a last resort, is a mistake. If this method of delivery is to be used at all it should be used at the proper time, and not wait until the uterus is molded tightly about the fetus. We also believe that the use of bags or pituitrin in the first stage of labor is contraindicated, because bags are prone to displace the presenting part allowing a prolapse of the cord and a possible detachment of the

placenta causing death of the child. Pituitrin likewise causes fetal mortality by producing uncontrollable uterine contractions.

Regarding the use of antiseptics our experience leads us to the conclusion that soap and water generously used meet all the requirements necessary.

We also believe that the proper ironing out of a birth canal before the introduction of a hand is most important, and this procedure, if done properly and carefully, makes episiotomy unnecessary. The argument put forth that the fascia beneath the vaginal mucosa is separated is greatly exaggerated.

It is important at this time to again emphasize that haste in the extraction of the fetus is not only unnecessary but harmful, because of the damage liable to occur to the soft parts of the mother and the loss of flexion, which is so essential in the proper extraction of the fetus. It has often taken us as long as twenty minutes to complete the delivery of the child after the navel has appeared at the vulva.

It is allowable at all times to make gentle, steady traction upon the child as long as the child moves through the birth canal. When the child does not move careful examination to determine the cause must be made. The most frequent obstruction encountered is the umbilical cord between the legs. This should be cut to allow the continuous passage of the child and a hemostat is applied to the cut cord as it appears at the vulva.

Another cause of delayed descent of the child is a prolapsed arm. When this occurs no attempt at replacement of the arm should be made but as the fingers of the child appear at the vulva, the operator grasps the fingers with a piece of gauze making gentle traction and delivering the hand and arm along side the body of the child.

We never cover the body of the child during the extraction with a warm towel and neither do we twist or grasp the body during extraction because of possible injury to the internal organs. Much more satisfac-

tory traction is obtained and along with it spontaneous rotation of the body if traction is made upon the feet by grasping them between the first and middle fingers. No slipping is possible if pressure is made upon the index finger by the thumb. It should also be remembered that rotation of the back is aided many times by greater traction on the anterior leg.

The delivery of both shoulders as anterior shoulders, we believe, is a decided improvement in the technic, because we more easily avoid perineal tears and are less prone to get infections because of possible contact with the rectum.

As a practical point we have noticed that since the intravenous use of pitocin immediately following the third stage of labor, the blood loss has been reduced materially and it is a good procedure regardless of the type of delivery.

We are also of the opinion that at all times the birth canal should be carefully examined and the necessary repairs made immediately following delivery, whether it is in the home or in the hospital. Immediate repairs of cervical injuries tend to aid involution of the uterus and at the same time, it is possible to remove old scar tissue and infected cervical cysts in multiparae, but care should be exercised not to remove too much tissue.

Comment was made in 1928 by the senior author to the effect that unilateral tears appear on the side of the cervix where the occiput has remained the longest. For example, in prolonged left occiput posterior positions it would appear on the left side and right occiput posterior positions on the right side, thus emphasizing the damage from prolonged posterior positions. Since making that observation we have seen no reason for changing our opinion.

Resuscitation of the child, when necessary, is accomplished by treating the child as a patient in shock. Dry external heat is applied by warm towels, mucus is aspirated from the trachia by means of a small rubber catheter and air is introduced directly into

the lungs by blowing into the catheter gently and expelling the same by gentle pressure on the chest of the child. The heart beat and the color of the child are the indicators of its condition, and if the heart beat is present the resuscitation is usually successful. We have for years discarded the procedure of the so-called tubbing and spanking of the child, as being entirely out of place in the treatment of a shocked patient.

SUMMARY

An attempt has been made to simplify, clarify and standardize the technic of podalic version and extraction.

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THE symptoms of carcinoma of the ovary in the earlier stages are those of any other solid ovarian tumor and are usually absent until rupture of the capsule has occurred, when recurrent pain, ascites, and cachexia make their appearance.

From "Essentials of Gynecology" by Willard R. Cooke (J. B. Lippincott Company).

KINETIC DISABILITIES OF THE HAND AND THEIR CLASSIFICATION*

A STUDY IN BALANCE AND IMBALANCE OF THE HAND MUSCLES

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THE normal hand is kinetically balanced. The muscles, serving *common* flexion and extension, which begin in the forearm and end by tendon in the hand, are the *extrinsic muscles*. The muscles, arising and ending in the hand are *intrinsic muscles*, of which there are five groups: the thenar grouping, the adductors of the thumb, the hypothenar grouping, the lumbrical muscles and the interossei muscles.

The examination of the hand is made systematically. Common flexor power is set against common extensor power, extrinsic power against intrinsic power, and intrinsic power against intrinsic power. The normal hand is easily known; the kinetically imbalanced hand needs detailed study.

This is a study of the hand whose function is changed by *paralysis, contracture* or *muscular imbalance*. It excludes infections of the hand, fractures, many forms of trauma, and tumors of the hand.

The problem is simplified by dividing hand disability into four groups: *the kinetic disabilities of the spastic hand, the arthritic hand, the paralytic hand,* and *the traumatized hand.* Each muscle grouping is analyzed in each of these four divisions of disability.

Finger Rebound Phenomena. When either the flexor or extensor mechanism of a finger is passively tensed, finger rebound takes place on sudden release of tension. Two rebound phenomena are normal and constant.

Extensor Rebound. If the finger is extended actively at its three joints, release of the passively flexed end phalanx snaps this phalanx back into extension. This *extensor rebound* is also seen in the intrinsic position of the finger and is strong even in palmar flexion of wrist. Passive flexion of the end phalanx tenses the extensor mechanism and release of tensing flexion causes rebound of the phalanx into extension.

The extensor rebound is the rebound of intrinsic extension and not of the whole extensor apparatus of a finger, except when the finger is on a line with its metacarpal. This is made clear in radial nerve palsy. The end and middle phalanges extend actively and there is a good extensor rebound; it is not possible to extend the proximal phalanges. In ulnar nerve palsy, there is no extensor rebound, although the common extensor tendons are strong.

Flexor Rebound. The flexor rebound is a confirmatory test of flexor profundus power of a finger. The finger, being actively hyperextended at the metacarpophalangeal joint and hence flexed at its two distal joints, snaps back into flexion on release of passive extension of the end phalanx. Flexor sublimis rebound is not striking.

Increasing flexion of the proximal joint increases flexion of the distal joint and hence flexor rebound of the distal phalanx. Flexor rebound lessens as flexion of the distal joint decreases. Rebound is lessened in extreme palmar flexion of the wrist except in hyperextension of the metacarpophalangeal joint with associated finger flexion. It is weak in acute metacarpophalangeal joint flexion and disappears when the metacarpophalangeal joint is placed between 165° and 180°, with accom-

panying slight flexion of the interphalangeal joints. This is a narrow field of tension equality in which extensor or flexor rebound

FIG. 1. The intrinsic deformity of the thumb in an arthritic hand. The ulnarly deviated fingers are also held in the intrinsic position.

is absent. If balance between flexor and extensor strength is broken, a rebound may take place in the neutral field.

The *abnormal rebounds* indicate a state of increased tension in one or more of the muscles controlling the finger.

Common Extensor Rebound. In two cases of absent flexor tendon function a *common extensor rebound* was seen. When the finger was passively flexed at its proximal joint, release of pressure snapped the finger back into extension by common extensor action.

A *whole finger extensor rebound* is rarely seen in the spastic hand whose three phalangeal joints are in extension. Release of passive flexion of the finger at the metacarpophalangeal joint snaps it back into extension. It was also seen once in a hand whose ulnar bursa had been infected.

Flexor Sublimis Rebound. The flexor sublimis rebound is indicative of increased tension in the sublimis muscle of a finger. It is seen in long maintained flexion position of the proximal joint of a finger, as in ulnar nerve palsy. When the finger is passively extended at this joint, release snaps the finger back into flexion.

Interosseous Rebounds. These may be divided into two groups: the *lateral interosseous rebound* and the *flexor interosseous rebound* or *whole finger rebound.*

The *lateral interosseous rebound* is due to an increased state of tension of one interosseous muscle of a finger over its balancing interosseous muscle. This is tested when the finger is passively held in intrinsic position in lateral deviation *opposite* to the action of the stronger interosseous muscle tested and then released. (A *lateral extensor rebound* of the finger at the metacarpophalangeal joint by common extensor action is differentiated from the lateral interosseous rebound because the former is tested in extension of the metacarpophalangeal joint. A particular form of this rebound is that of the little finger in extension-abduction position, which, when brought to the ring finger, rebounds to its pristine position on release.) The *flexor interosseous rebound* indicates a state of tension in the interossei of a finger greater than common extensor tension. The sum effect is to maintain the finger in intrinsic position *without* lateral deviation. The rebound is tested by bringing the finger passively into extension at the metacarpophalangeal joint, the end phalanges remaining extended. The finger snaps back into the intrinsic position on release. The same rebound is seen in the thumb, when the flexor brevis pollicis has a tension greater than that of the extensor brevis pollicis. Since the whole thumb is snapped back, the phenomenon may be called a *whole thumb rebound,* since it corresponds to a whole finger rebound.

Given two balancing muscles which are not structurally shortened, *the strength of one over the other* is tested by the in-

creased tension state of the stronger. This increased tension made possible by muscle contraction, is recognized by the rebound · which takes place on release of the tension force. This belief presupposes a direct relation between muscle tension and muscle strength which may not always be true. The increased tension of a spastic muscle does not necessarily bespeak its greater *absolute* strength, but if its rebound exceeds its balancing antagonist, it has relatively greater strength than its opponent muscle. Probably the purest value of the rebound is seen in the paralytic hand. The paralyzed muscle cannot tense nor contract while its active antagonist can do so.

When a muscle is structurally shortened as in arthritic (myositic) contracture, its increased tension state does not mean increased absolute strength. Its range of motion is less and so must be its power. But it is relatively stronger than its antagonist if its testing rebound is greater.

The rebound phenomena hence only test *relative* strengths of balancing muscles. This is their significant clinical use.

KINETIC DISABILITIES OF THE THENAR MUSCLES—THE INTRINSIC DEFORMITY OF THE THUMB—THE SEQUEL OF RECURRENT ULNAR LUXATION OF THE EXTENSOR LONGUS POLLICIS

This is a not uncommon deformity of the thumb and is like the intrinsic deformity of the finger. The thumb is flexed at the metacarpophalangeal joint and extended or hyperextended at the interphalangeal joint. The first metacarpal bone is either in opposition position or in abduction.

Flexion of the metacarpophalangeal joint is by pull of the flexor brevis pollicis. Extension or hyperextension of the interphalangeal joint takes place as a synergistic movement as the thumb is flexed at its metacarpophalangeal joint by pull of the fascial band which passes to the dorsum of the second phalanx from the abductor brevis pollicis, or by pull of the extensor longus pollicis, or a combination of these

factors. In time, the deformity becomes fixed.

The deformity is caused by the imbalance between a weak or absent extensor brevis pollicis and a strong flexor brevis pollicis. The flexor longus pollicis plays a secondary part, for the intrinsic deformity may develop when long flexor action is absent. In one case, an intrinsic deformity of the thumb followed section of the flexor longus pollicis distal to the insertion of the flexor brevis pollicis.

Weakness of the flexor longus pollicis is usually more apparent than real. The end phalanx of the thumb may not be flexed actively more than a few degrees in the intrinsic position of the thumb. When the thumb is passively extended at the metacarpophalangeal joint, active flexion of the end phalanx may become full and strong. The flexor longus pollicis may, however, be secondarily weakened by persistent hyperextension of the end phalanx.

The intrinsic deformity is seen in three of the four principal groupings of hand disabilities: the traumatic, the spastic, and especially, the arthritic hand. It is rarely seen in the paralytic hand, since the thenar muscles of which the flexor brevis pollicis is a part, are so frequently paralyzed. Mild deformity is sometimes observed in median nerve paralysis, because the ulnar head of the flexor brevis pollicis is supplied by the ulnar nerve. Tear of the extensor brevis pollicis, or strain of or blunt injury to the dorsal capsule of the metacarpophalangeal joint of the thumb (in which the extensor brevis inserts) is followed sooner or later by the isolated development of this deformity, even as early as a month after injury. It is but one of other deformities in the arthritic or spastic hand. In the arthritic hand, it is usually due to arthritis of the metacarpophalangeal joint of the thumb.

The major disability of this deformity is the limitation of flexion of the end phalanx of the thumb. Opposition is possible and may reduce the degree of deformity. The patient may be able to do most types of

work, but yet have difficulty with certain occupations, as typing.

Secondary disabilities may arise, especially after the thumb has become fixed in

FIG. 2. A, the intrinsic deformity of the right thumb in the case of the girl with recurrent ulnar luxation of the tendon of the extensor longus pollicis. The distal phalanx is in extension but not hyperextension. The left hand shows ulnar deviation of the fingers secondary to arthritis of their metacarpophalangeal joints.

the position of deformity. The anterior capsule of the metacarpophalangeal joint becomes contracted and, while it may be possible to extend the thumb passively at the metacarpophalangeal joint, release of the thumb snaps it back into flexion (whole thumb flexor rebound). The dorsal capsule of the interphalangeal joint also is contracted. The interphalangeal joint rarely shows secondary destructive arthritis. Recurrent ulnar luxation of the tendon of the extensor longus pollicis is an unusual sequel. This luxation of the tendon is an accentuation of a normal movement—the slight medial and lateral riding of the tendon over the humped dorsum of the metacarpophalangeal joint on flexion and extension of the end phalanx in the intrinsic position of the thumb.

Treatment is usually not necessary. Splinting of the end phalanx in flexion reverses the position of deformity, with some synergistic extension of the first phalanx at the metacarpophalangeal joint. The surgical correction of this disability can be accomplished by the stripping of

the thenar muscles. The flexor brevis pollicis must be sectioned fully, as well as the anterior capsule of the metacarpophalangeal joint.
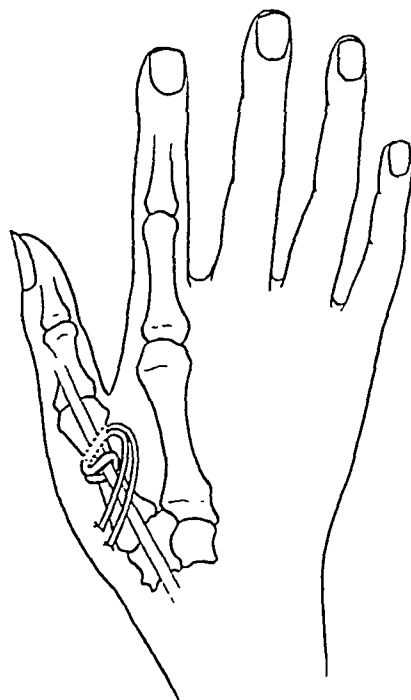

FIG. 2. B, loop retention of the luxating tendon is illustrated in this diagram. The operative technic is described in the text. The loop is so placed that it prevents ulnar luxation of the tendon of the extensor longus pollicis.

INTRINSIC DEFORMITY OF THE THUMB AND RECURRENT MEDIAL OR ULNAR LUXATION OF THE TENDON OF THE EXTENSOR LONGUS POLLICIS

CASE I. Gertrude R., twenty-one, was employed for seven months as a trimmer of scarfs and mufflers in 1934. She made many thousand cutting movements with heavy scissors each day, the scissors reaching to the base of the thumb, making each cutting movement painful. Two weeks after she began this work, her right thumb became swollen, and in another two weeks, she noted "dropping" of the thumb. She also had infectious arthritis of the left hand and wrist.

The right thumb showed an intrinsic deformity, flexion position of 160° being present at its metacarpophalangeal joint. The metacarpophalangeal joint was swollen and painful

dorsally. Tenderness was present along the course of the extensor brevis pollicis. The thumb was held in adduction and she could not abduct it actively. The thumb rested

thumb was actively or passively extended, the long extensor tendon slipped radially into place with an audible sound as it passed over the medial tuberosity at the base of the first

Fig. 3.

Fig. 4.

Fig. 3. The extrinsic deformity of the thumb in the spastic hand. This is a mutable deformity. There is anterior subluxation of the first metacarpal head by the marked hyperextension position of the metacarpophalangeal joint. The wrist is in neutral position.

Fig. 4. A fixed extrinsic deformity of the left thumb. This man has a combined palsy of the ulnar nerve and posterior interosseous nerve following a bullet wound on September 7, 1938. Suture of the ulnar nerve was done on January 11, 1939, with slight return of power. A wrist fusion was carried out on April 4, 1939. The extension contracture of the middle, ring, and little fingers was released by a Shaw operation early in 1940, and the thumb and index finger were operated upon on June 13, 1940. Capsulotomy of the metacarpophalangeal joint of the thumb with section and stripping of its very thickened collateral ligaments, manipulation of its interphalangeal joint, capsulotomy of the carpometacarpal joint, and adductor section were needed to correct this deformity at the time of operation, an improvement which has not been maintained. On June 5, 1941, tendon transplants were done to give common extension to thumb and fingers. (These operations were done by various surgeons on the Service of Dr. Sonnenschein.) This photograph was taken on December 16, 1939, before attempt at correction.

against the index and middle fingers but she could carry it across to the little finger. This inability to abduct the thumb was due to ulnar luxation of the tendon of the extensor longus pollicis. When the end phalanx of the

phalanx. The tendon could also be replaced by passive radial pressure against it. This corrected the intrinsic deformity of the thumb. The thumb could then be abducted and execute a grasping movement. The flexor longus

pollicis, the adductors of the thumb and the thenar muscles seemed normal.

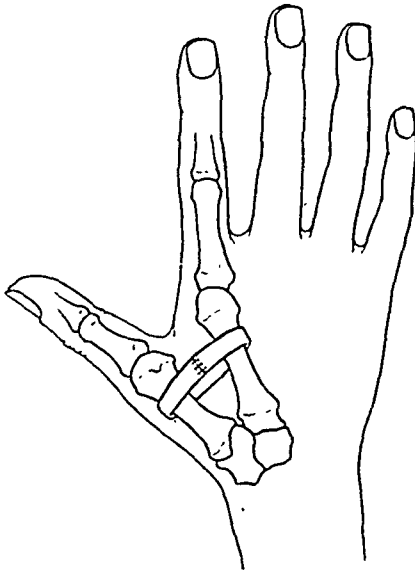The left wrist was mildly scaphoid over its

FIG. 5. Sketch of fascial loop operation for athetoid or dystonic opposition of thumb.

dorsum. There was mild atrophy of the dorsal interossei muscles. The major disability of the left hand was an ulnar deviation of the fingers at the slightly flexed metacarpophalangeal joints. These joints were somewhat swollen and tender. This arthritic involvement, greatest in the index finger and last in the little finger, caused increased lateral mobility of the metacarpophalangeal joints, both in flexion and extension. It was possible to correct the deformity passively but the ulnar deviation of the fingers was again assumed on release of pressure.

The operative procedure—loop retention of the luxated tendon—was advised by Dr. Leo Mayer, and it was on this idea of his that I did the operation on February 12, 1936.

A longitudinal dorso-ulnar incision was made, beginning about three-quarters of an inch above the metacarpophalangeal joint of the thumb and extending proximally along the shaft of the first metacarpal bone. The extensor longus pollicis tendon was identified and its medial displacement verified. The tendon was less shiny than normal and its edges were ragged. The loose and redundant capsule of the metacarpophalangeal joint was edematous, thickened and grayish in color. The periosteum of the first metacarpal bone was thickened and

swollen. A tendon loop was made from part of the tendon of the palmaris longus.

In the third stage of the operation, a slightly oblique drill channel was made about one-half inch beneath the head of the first metacarpal, the radial end being a little more proximal. The tendon graft, shaped to fit this channel, was made somewhat thicker at its middle and tapered at each end, care being taken not to injure its gliding surface at the point of contact with the extensor longus pollicis. A Bunnell-Mayer suture of black silk was taken at each end of the tendon. The loop was passed about the extensor tendon so that it pulled it in a radial direction. The tendon ends were directed through the drill channel in the bone by means of a previously introduced guide suture of heavy black silk. The tendon ends, in order that the loop exert a radial pull, went in from the proximal and radial side of the bone to its distal and ulnar side. The tendon ends on the ulnar side of the bone were now brought over dorsally and sutured separately under some tension, to the adjacent tissues radially. It was made sure that the extensor longus pollicis tendon moved freely in the loop. The loop was effective in retaining the tendon in place. After the wound was closed, the thumb was immobilized in abduction and in extension.

The postoperative course was uneventful. She was unco-operative in postoperative treatment.

The ulnar deviation of the fingers of the left hand, quickly overcome by a U-shaped plaster mold which brought the fingers radially, later recurred.

This ulnar deviation is conditioned by position. I was unable to duplicate it by the experimental injection of water into the metacarpophalangeal joints of the hand of a cadaver. Distention by synovial hypertrophy and ligamentous laxity allow postural factors to play an important part, but distention of the joint alone does not reproduce the deformity.

She was seen last in October, 1938. She had worked as a typist for some time but had to discontinue this work because she could not bend the thumb at the interphalangeal joint. The thumb was not swollen. It was held in the intrinsic position, flexed to 90° at the metacarpophalangeal joint, and extended at the interphalangeal joint. The metacarpophalangeal joint could be extended to 100° actively and 180° passively. Release of passive tension
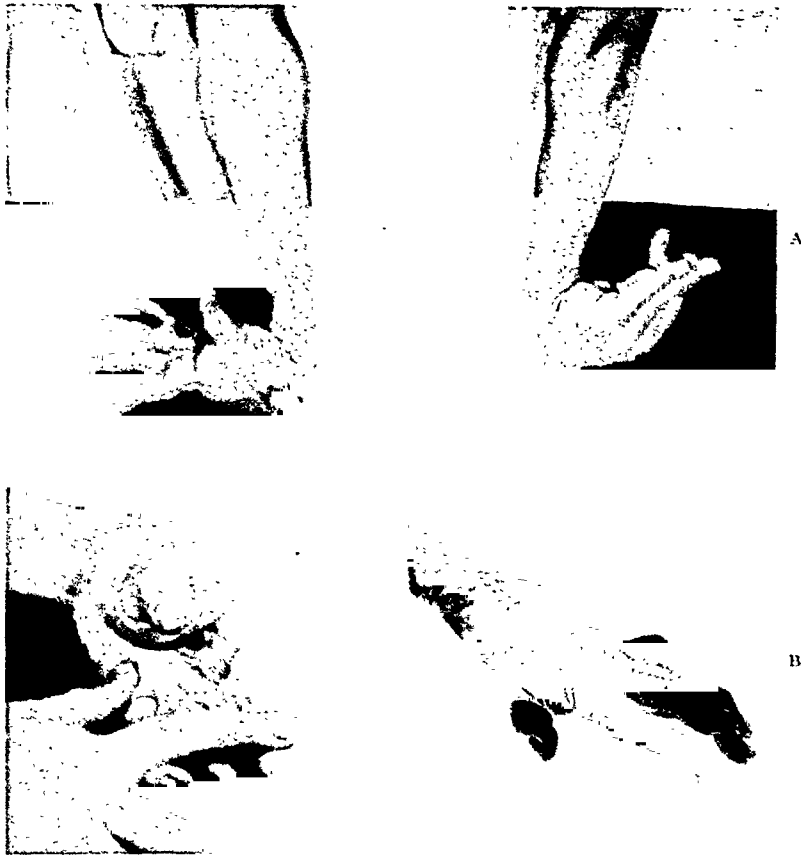
Fig. 6. A, the spastic hand and wrist by extrapyramidal tract lesion. The patient is a man of fifty-six. This photograph was taken on October 16, 1939, and shows an extreme flexion deformity of the wrist in ulnar adduction. The elbow was extended. The fingers were usually in the intrinsic position, but sometimes showed dissociated position or extension at all three phalangeal joints. The intrinsic deformity of the fingers decreased from the little finger to the index finger. The first metacarpal bone was opposed in extension of the metacarpophalangeal and interphalangeal joints. The first metacarpal head was subluxated anteriorly. When he tried to make a fist, there was increase in intrinsic position of the fingers. When the wrist was brought up passively into lesser palmar flexion, the fingers flexed and the thumb went into the palm. When the elbow was bent actively, flexion of the fingers increased and there was greater resistance to passive dorsiflexion of the wrist. The muscles arising from the internal epicondyle of the humerus tensed as the elbow bent and the forearm pronated. B, wedge plasters were applied to bring the wrist into lesser palmar flexion. On April 18, 1940, the internal epicondylar muscles were stripped from their origin and partial neurectomy of the branches of the ulnar and median nerves to these muscles done. It was thereafter possible to bring the wrist into about 20° (160°) of palmar flexion. On August 3, 1940, the tendon of the flexor carpi ulnaris was lengthened and a wedge removed from the wrist joint with dorsal base, the proximal part of the distal carpal bones being removed in this wedge. This is a postoperative photograph taken on November 16, 1940, showing the position of the wrist and fingers after the two-stage operation. Finger power is better.

snapped the thumb back into flexion by elastic rebound due to tightness of the flexor brevis pollicis (a whole thumb flexor rebound). In the intrinsic position of the thumb she could not flex the end phalanx more than five degrees, but, in maintained passive extension of the metacarpophalangeal joint, flexion was almost complete. The strength of the other muscles of the thumb was good. The luxation of the extensor longus pollicis was well corrected.

This injury of the thumb is occupational. No joint of the affected hand was arthritic. The intrinsic deformity of the thumb came first and then the luxation of the tendon; hence, the flexion deformity of the metacarpophalangeal joint of the thumb should have been corrected first, and then the luxation of the tendon.

CASE II.   In another young woman in her twenties, an excess ulnar movement of the right extensor longus pollicis tendon was present on flexion of the end phalanx. This disability was occupational. She folded large (8" × 10") card boards on which metal hair curlers were to be mounted and punched holes in them at the same time. She had done this movement several thousand times a day for four months.

Two months before examination, she had noted a clicking of the tendon of the extensor longus pollicis, as the tendon slipped back and forth. The thumb was splinted for a month and clicking ceased. Since then she had pain on the radial side of the hand and forearm, due to a tendovaginitis of the sheath of the short extensor and long abductor of the thumb.

The thumb did *not* show the intrinsic position. The ulnar mobility of the tendon of the extensor longus pollicis was abnormal, in that it exceeded by far the mobility of the same tendon of the left hand. The subluxating tendon did not click. The thumb was held somewhat abducted and flexed at both its joints as the tendon moved ulnarly; extension of the thumb was restored at its original position. Opposition of the thumb was limited, as were wrist motions.

In this occupational injury it was necessary for the thumb to assume the intrinsic position repeatedly during the day's work. Secondary luxation of the extensor longus pollicis followed, even though the thumb did not remain permanently in the intrinsic position.

EXTRINSIC DISABILITIES OF THE THUMB

Certain extrinsic disabilities of the thumb are described, the most interesting of which is the extrinsic deformity of the thumb. The usual disabilities, stenosing tendovaginitis of the sheath of the flexor pollicis, DeQuervain's stenosing tendovaginitis at the wrist, tendon lacerations of the thumb and their repair, are not discussed here.

EXTRINSIC DEFORMITY OF THE THUMB

In the extrinsic deformity of the thumb, there is extension or hyperextension of its metacarpophalangeal joint and flexion of the interphalangeal joint. The degree of end phalanx flexion (sometimes 90°) influences and is usually much greater than the degree of metacarpophalangeal joint extension. There may even be anterior subluxation of the first metacarpal head. It is more probable that the deformity will develop in greater end phalanx flexion than in lesser. The first metacarpal bone is more often in abduction than in opposition.

When the thumb is abducted in the plane of the hand, there is associated extension of both its metacarpophalangeal and interphalangeal joints. The extensor longus pollicis tendon moves radially and does not stand out as a tight cord. If the distal joint of the thumb is now flexed, the metacarpophalangeal joint being extended (the extrinsic position), the degree of abduction of the thumb synchronously lessens and it becomes impossible to abduct the thumb beyond this limit by tightness of the tendon of the extensor longus pollicis. This movement is a painful strain movement, especially in the muscle belly of the taut adductors. It is most difficult to execute this position of the thumb in the intrinsic position of the fingers.

It is a less common deformity than the intrinsic deformity of the thumb. It may be voluntarily produced by the normal hand but in an unnatural position of strain.

Passive pressure dorsally on the volar aspect of the proximal phalanx of the thumb puts the thumb into the extrinsic

position, the end or distal phalanx flexing at the same time. When the tip of the thumb is held against the radial side of the

When the flexor longus pollicis bends the end phalanx acutely, and the metacarpophalangeal joint is stabilized, the

A   B

FIG. 7. A, a thumb made of a synthetic plastic material. This thumb was made by Dr. Edward Klein and colored by Paul Peck, medical illustrator. B, the stump of the thumb is shown in the illustration on the left. Osteotomy of the base of the first metacarpal of this paralytic thumb to place it in opposition position, and release of flexion contracture of the distal phalanx ended in gangrene of the distal phalanx, the vascular interruption being more probably due to the flexion release. On the right, the artificial thumb is in place. The fairly deep cup of this thumb exerted suction effect so that it required some moderate pull to remove it.

index finger, the thumb may go into the extrinsic position.

The extrinsic deformity is due to imbalance of power between the flexor longus pollicis and the common extensors (usually the extensor longus pollicis) in favor of the former. When the flexor brevis pollicis is weak or paralyzed, the deformity develops more easily; yet it is not a *sine qua non* of the deformity that this intrinsic muscle be weak. It is absolutely necessary that the flexor longus pollicis be either stronger than its opposing extensor, or that its muscle belly be structurally shortened. Yet, there must also be stabilization or fixation of the metacarpophalangeal joint so that it does not flex when the interphalangeal joint flexes. This fixation may develop by various cause, as inability to bend the metacarpophalangeal joint in paralysis of the thenar muscles, arthritic fixation, the habitual resting of the thumb against the index finger, and persistent extension (tension) pull of the extensor brevis pollicis. The deformity is favored by dorsiflexion of the wrist, especially when it is mutable; it is, however, also seen in fixed palmar flexion of the wrist.

tendons of the extensor brevis and extensor longus pollicis stand out as tight cords, the tension pull of which tends to extend or to increase extension of the metacarpophalangeal joint. Similar tension pull of the extensor tendons is seen in the *extension variant* of the finger deformity. The position of deformity once assumed is maintained by a probable bow string action of the flexor longus pollicis.

The extrinsic deformity of the thumb is a clawing deformity of the thumb but it is not directly comparable with the claw finger caused by paralysis of the intrinsic muscles of the finger. Functionally speaking, the thumb, being two-jointed, does not need the balancing (intrinsic) mechanism of the three-jointed fingers, and hence does not have a lumbrical muscle.

This deformity occurs in all of the four principal groupings of hand disabilities. In the *spastic* hand, it is a mutable deformity, developing only on dorsiflexion of the wrist. The thumb is either in or out of the palm in palmar flexion; as the wrist is dorsiflexed, the shortened flexor longus pollicis draws the end phalanx of the thumb into marked flexion. The extensor brevis

pollicis tendon becomes taut and its tension pulls the metacarpophalangeal joint into extension. Mutability of this deformity

means lack of contracture of the metacarpophalangeal joint. Occasionally, the *athetoid* hand shows the intermittent development of this deformity. The atrophic and spastic hand of *amyotrophic lateral sclerosis* may show an extrinsic deformity of the thumb, and this may be of help in the diagnosis of this malady. The thenar muscles, including the flexor brevis pollicis, are atrophic so that the metacarpophalangeal joint is not bent by their action, this resulting ultimately in fixation of the joint. Given a strong or relatively stronger flexor longus pollicis, the extrinsic deformity follows after fixation of the metacarpophalangeal joint.

The deformity is not usually seen in the *poliomyelitic hand.* I observed it once. The thenar muscles were atrophic, the long flexor of the thumb short, and the extensor

longus pollicis paralyzed, the wrist being held in slight dorsiflexion. There was definite restriction of motion of the metacarpophalangeal joint of the thumb and fixation of this joint helped create, the extrinsic deformity.

The extrinsic deformity may sometimes be seen in the peripheral nerve palsies. Yet, neither median nerve nor ulnar nor radial nerve predominance creates this deformity. In ulnar nerve palsy, however, the thumb may show a mutable extrinsic deformity during substitutionary adduction action of the extensor longus pollicis. The deformity was seen in a man whose hand was paralyzed by a *combined ulnar nerve and posterior interosseous nerve* palsy. The thumb rested against the radial side of the flexed index finger. The deformity may also have been due to poor splinting of the hand. The extrinsic deformity was observed in the paralytic thumb (ulnar and median nerve paralysis) after a Bunnell operation as a transient phase of movement as the thumb was brought across the palm. It was also noted in a man with a combined ulnar and (partial) median nerve palsy, in whom the thumb went into extrinsic position as he brought it forward in intrinsic abduction.

The *arthritic* hand will show this deformity only if there is *arthritis of the interphalangeal joint of the thumb,* even in palmar flexion of the wrist. This joint is not ordinarily involved in rheumatoid arthritis. The resultant flexion deformity of the end phalanx secondarily extends or hyperextends the metacarpophalangeal joint; if the arthritic wrist is flexed palmarly, pull of the stretched extensor brevis pollicis will hyperextend this joint, too.

The extrinsic deformity was seen in the osteo-arthritic hand of an elderly woman, the dorsum of whose metacarpophalangeal joint of the thumb showed moderately sized Heberden's nodes.

The deformity may sometimes develop as a mutable thing when the extensor longus pollicis is injured at the level of the metacarpophalangeal joint; it is present

in dorsiflexion but not in palmar flexion of the wrist.

The extrinsic deformity is then either a fixed, since this is the principal element of deformity. This should be combined with capsulotomy as indicated.
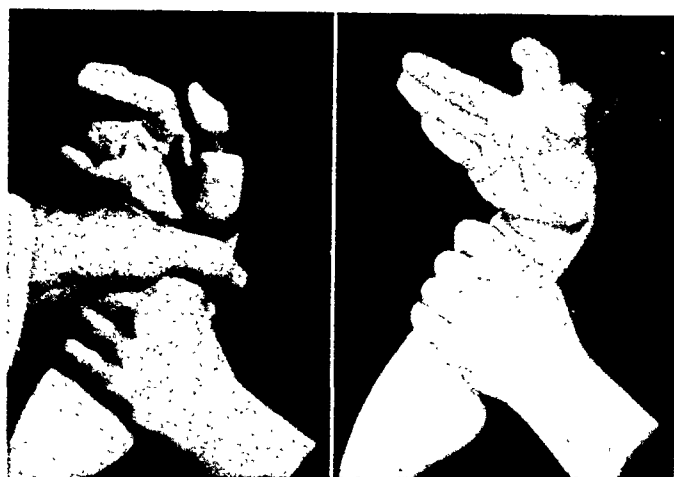

Fig. 8. b, leather strap holding the dystonic thumb abducted.

local thing or part of a complex hand deformity. When deformity is fixed, it may be associated with adduction or pseudo-adduction contracture of the thumb, the position in which the thumb is maintained favoring this other deformity.

This deformity should be prevented by splinting the thumb in a neutral position. If the deformity is mutable, the *treatment* of choice depends on the underlying condition—freeing or suture of the torn extensor longus pollicis or the placing of the spastic hand in a neutral field.

The arthritic interphalangeal joint should be splinted in extension, the wrist being held in slight dorsiflexion.

Operative release of the fixed deformity may be necessary. In only one case was release done—the case of the man with combined ulnar nerve and posterior interosseous nerve palsy. Capsulotomy of the metacarpophalangeal joint of the thumb, including section of the very hypertrophic collateral ligaments, capsulotomy of the carpometacarpal joint, manipulation of the interphalangeal joint into extension, and section of the tight adductors gave fairly good immediate correction of the deformity but lesser ultimate improvement.

The flexor longus pollicis should be lengthened in the wrist, if the deformity is

Proper postoperative splinting and physiotherapy is necessary.

SNAPPING OF THE TENDON OF THE EXTENSOR LONGUS POLLICIS

CASE III. A man of thirty voluntarily luxated and snapped his left extensor longus pollicis. This tendon rode over a small bony prominence at the base of the first metacarpal.

When the wrist was flexed palmarly in a little ulnar adduction, the thumb was held in opposition of the first metacarpal bone, in extension at the metacarpophalangeal joint and hyperextension at the interphalangeal joint. The tendon rode with a loud thud over this bony prominence as the thumb was moved. He was able to do the same thing when the wrist was moved, and the thumb held fixed to the fingers in opposition and extension as noted.

This snapping (acquired in childhood), was possible only in one hand. Repetition of luxation was painful.

This luxation is uncommon; it is different from the recurrent luxation associated with the intrinsic deformity of the thumb.

LUXATION OF THE TENDONS OF THE ABDUCTOR LONGUS POLLICIS AND EXTENSOR BREVIS POLLICIS AT THE WRIST

This is a most unusual luxation, only two cases of which have been recorded.

In *Goddu's* case,[1] a woman complained of disability of the hand which had followed a recent trauma to the right wrist. The easily replaced but luxation was painful. A fascial loop operation was recommended to keep the tendon in place.
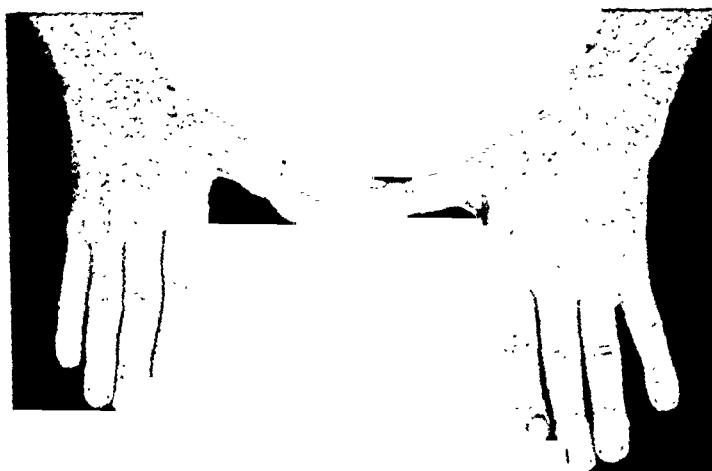

FIG. 9. This is the right hand of a Spanish Loyalist Veteran, who had ankylosis of elbow and wrist after an infection of the forearm by a bullet wound. The adductor contracture of the thumb seemed due to improper splinting. On December 7, 1938, adductor section and wrist fusion were done. Later, he had a resection of the elbow. This photograph, taken October 10, 1939, shows comparative spread of each thumb and the mild volar rotation of the right thumb. This rotation is a sequel of adductor section. ·

thumb gave way so that she dropped things. The pain was localized to the region of the lower end of the radius and base of the thumb. There was a marked laxity of the joint between the first metacarpal bone and the greater multangular. At times, a distinct snapping of the thumb was heard as the thumb was abducted because of luxation of the tendon of the extensor brevis pollicis out of its groove.

The luxation of the short extensor of the thumb seemed to be due to shallowness of the groove in which it rested. This groove was deepened so that the tendon was not injured. A fusion of the first carpometacarpal joint was done. The follow-up was more than two years. The result was good.

A case similar to Goddu's is mentioned in the "Queries and Minor Notes" of the Journal of the American Medical Association.[2]

On hyperextension of the thumb, the extensor pollicis brevis tendon slipped dorsally over the edge of the radius. It was

CASE IV.   Pauline C., twenty-one years old, complained of pain on the radial side of the left wrist for six months. There was no gross trauma. Pain was of variable intensity. Turning the wrist as in wringing clothes increased pain. She had heard clicking or snapping of the wrist radially and this caused radiation of pain up the forearm.

Motions of the wrist were good except that ulnar adduction was 10° less than normal. On ulnar adduction and slight dorsiflexion of the wrist, subluxation of the extensor brevis pollicis took place, the point of luxation being about $\frac{3}{4}$ of an inch above the radial styloid. Crepitation was also felt on this maneuver at the site of luxation. Snapping had also been noted when the thumb was manipulated ulnarly. Thumb movements were normal.

A diagnosis of luxation of the extensor brevis pollicis at the wrist was made. No treatment was given.

SPASTIC THUMB

The spastic thumb (and this includes the dystonic and athetoid thumb[3]) is drawn into the palm by spasm of the thenar muscles and flexor longus pollicis

and held there by the overlying flexed fingers, especially in the position of palmar flexion of the wrist. In dorsiflexion, the thumb is often drawn out of the palm. Usually, the first metacarpal bone is inwardly rotated in opposition when the thumb is indrawn, but sometimes it is in external rotation or abduction in dissociated action. The irregular alternation of hyperinnervational impulse in the athetoid hand leads to frequent positional change of the thumb, during which the thumb may assume the intrinsic position, dissociated position, and opposition position. Common extensor action may subluxate the first metacarpal head volarly, especially after thenar muscle stripping or lengthening of the flexor longus pollicis. It is, therefore, more likely that the spastic thumb, whose level of hyperinnervation is more or less constantly maintained, will show contracture in any of these positions.

The operation of thenar stripping,[18] with or without the lengthening of the flexor longus pollicis, has been described for the relief of opposition position or contracture of the thumb.*

This procedure is most likely to succeed in the spastic hand rather than in the athetoid or dystonic hand. One spastic patient was examined three and one-half years after operation and the thumb was still held out of the palm.

Since the procedure did not prove satisfactory in the athetoid, dystonic, or spastic hand with irregularly and frequently alternating spasticity, a fascial loop operation,

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* The incision used for thenar stripping may be used for infection of the radial bursa as an analogue of Henry's incision. In the experimental hand, the incision is adequate both for drainage of the thenar space and radial bursa. The incision avoids the digital nerves and the motor branch of the median nerve, since the thenar muscles are stripped subperiosteally from the first metacarpal bone. The flexor longus pollicis tendon lies midway between the first and second metacarpal bones, and about 1½ inches of it are seen. If the insertion of the thenar muscles is sectioned, more of the tendon can be examined.

A hemostat passed through the usual web incision for thenar space infections enters into the area exposed by this incision.

in addition to the stripping of the thenar muscles, was tried in two patients, one a girl with dystonic hemiplegia, and the other a boy with widespread spasticity. A fascial loop or sling was passed between the first and second metacarpal bones, the thumb being held in full abduction in the plane of the hand. The loop was expected to restrain opposition since it is from the useful position of abduction of the thumb in which opposition is most easily begun. This constant restraint was also expected to diminish thenar muscle spasm. A similar operation has been described by Henschen,[4] who reported a good result in one case.

Ultimately, both operations were failures, although at first the loop did seem to check opposition. There was no thinning of the shafts of the metacarpals in one patient whose hand was roentgenographed more than a year after the operation.

Tenodesis of the extensor brevis pollicis and abductor longus pollicis was tried experimentally, the tendons being fixed into the radius. Such a procedure is feasible only if these muscles are paralyzed. Fascial tenodesis was also studied.

NEUTRAL FIELD OF THE SPASTIC HAND

When the wrist is flexed palmarly, the fingers are held slightly flexed at the three phalangeal joints. If active muscle power is present, the fingers can be more easily extended than flexed in this position. When the wrist is brought into full dorsiflexion, the fingers are held flexed, especially at the proximal and distal interphalangeal joints and it is easier to bend the fingers than to extend them. As the wrist is gradually brought up into dorsiflexion, a position of the wrist in slight dorsiflexion, less than that in which the paralytic or non-spastic wrist is fused, is found in which flexor and extensor finger mobility and strength become fairly equal. This represents the neutral field of action.

The determination of the neutral field demands a freely movable wrist, either passively or actively. The field can not

be measured if the wrist is fixed in palmar flexion contracture.

A wrist fixed in palmar flexion contracture is influenced by the shortening of the tendon transplant and in epicondylar stripping, or in short, in any procedure aiming to increase extensor power and lessen flexor power.

A   B

Fig. 10. A, the right hand of a female spastic patient of twenty-seven. The right metacarpal bone was fixed volarly in opposition with resultant secondary pseudo-adduction contracture. The thumb presents a most unusual and extreme volar rotation. This preoperative photograph was taken on February 24, 1936. The hand was functionless but operative correction of the deformity of the thumb was done for cosmetic reasons and to permit some passive grasping. B, a post-operative photograph taken November 5, 1936, after stripping of the thenar muscles and capsulotomy of the metacarpophalangeal joint of the thumb. Derotation was not attended by any circulatory embarrassment. This patient was last seen in 1942. There is no active use of the hand or thumb.

muscles arising from the internal epicondyle of the humerus, and hence by the position of the elbow. When the elbow is flexed, these muscles become tight and offer increasing resistance to passive dorsiflexion of the wrist, the forearm being pronated. When the elbow is extended, there is lesser resistance to dorsiflexion of the wrist and the forearm is supinated. The stripping of these muscles from the internal epicondyle releases to some degree the fixation of the spastic wrist in palmar flexion, a point which has been made by others.

The use of the spastic hand is then dependent upon an interlocking, kinesiological relationship between finger position, wrist position, and elbow position. Wrist position subserves finger position, and elbow position conditions wrist position.

The significance of this neutral field has been stressed by Pusitz.[5] It is of particular importance if the spastic wrist is to be fused. It should be of comparative and corroborative value in flexor to extensor

PARALYSIS OF THE THENAR MUSCLES

The thenar muscles are not infrequently paralyzed in infantile paralysis, and in median nerve palsy or laceration of its motor branch, with resultant flat hand deformity. The inability to carry the thumb forwardly and across to the little finger is a serious disability.

The first metacarpal bone in the flat hand drops back dorsally so that it lies in the plane of the other fingers, and even behind them. The basal end of the first metacarpal and its articulating greater multangular are carried forward. The posterior capsule of the carpometacarpal joint becomes taut and the anterior capsule relaxed. In time, this contracture may fix the thumb so that it becomes difficult to oppose the thumb passively, as pointed out by Mayer.[6] Or, the joint between the carpal bone and the first metacarpal may be so relaxed that foreshortening of the first metacarpal with anterior displacement of the base of the first metacarpal

may develop, a deformity easily reducible by traction but recurring on extensor action of the thumb.

finger by an adduction movement anterior to the fingers.

The Steindler[7] and Bunnell[8] operations

Fig. 11. The hands of the man with bilateral pollex valgus, more marked on the right side. There is soft tissue swelling over the radial aspect of the metacarpophalangeal joint of the thumb. The thumb is not rotated dorsally. The right hand shows a mild adduction contracture but this is not shown here.

Thenar muscle paralysis is not commonly selective. When the abductor pollicis brevis is paretic, the thumb cannot be brought forwardly. When the opponens pollicis is absent, the thumb can not be rotated. Selective paralysis of the flexor brevis pollicis (as in ulnar nerve palsy) is rarely seen, its loss giving presumptive lessened flexion of the metacarpophalangeal joint. In selective thenar palsy, especially in opponens palsy, the thumb can be brought to the little finger in a pseudo-opposition maneuver, the flexor longus pollicis participating in the movement, if it has good strength.

Before any operative procedure the residual power of the hand is reckoned with regard to possible source of muscle and tendon transplantation.

In any operation, passive opposition must be complete, if active opposition is to be expected. It is always difficult to duplicate the normal action of the thenar muscles, which is a carrying-forward and a carrying-across of the thumb. Not infrequently, only a form of opposition is obtained after operation—pseudo-opposition—in which the thumb is carried to the little

are most used for the restoration of some degree of opposition action of the thumb. Other operative procedures have been described by Ney,[9] Royle,[10] and others.[11] The Bunnell operation has the widest application, for it utilizes as a motor a flexor of the wrist or finger, which is attached to a free tendon transplant passing through an artificially created tendinous loop for better leverage and alteration of line of pull. The line of pull is made oblique and the free tendon graft is sutured to the region of insertion of the thenar muscles.

The importance of contracture of the dorsal part of the carpometacarpal joint of the thumb is stressed by Mayer. Release of this contracture allows opposition after the Bunnell operation and avoids pseudo-opposition. The most ulnar part of the capsule must be incised to give free passive opposition of the thumb. In one case this part of the capsule and the capsule of the joint between the greater and lesser multangular bones were cut before free passive opposition was allowed. Adduction contracture of the thumb must also be overcome to allow use of the thumb in opposition

after the Bunnell or other tenoplastic procedures. Such contracture was noted in two patients, in one of which good opposition

later made for this woman and she used this to hold objects with some satisfaction.
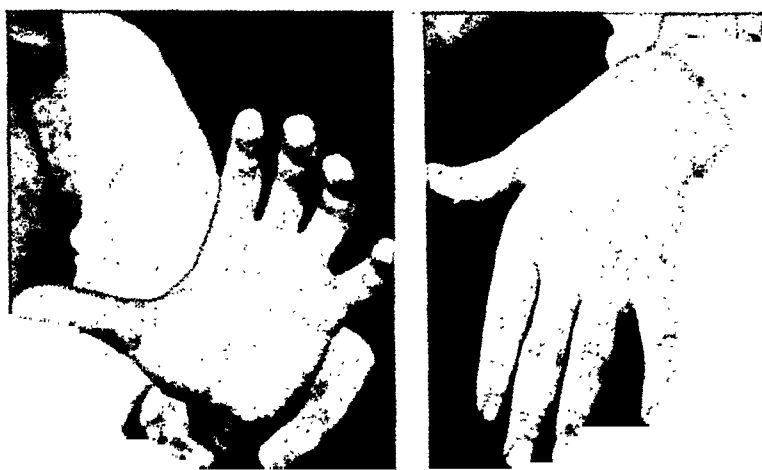
Fusion of the carpometacarpal joint of

Fig. 12. The left hand of G. S. whose case is reported in detail in the text. The marked atrophy of the first dorsal interosseous space is indicated by its hollowing in the photograph on the right. The contracture in intrinsic ulnar adduction of the index finger and the abduction contracture of the little finger are well shown.

was possible after adductor section. The Steindler operation utilizes the radially split half of the flexor longus pollicis which is transplanted dorsolaterally to the base of the first phalanx of the thumb. It should, however, be noted that a strong long flexor, even when not transplanted, may carry the thumb to the little finger in pseudo-opposition.

Steindler reports acceptable results of this flexor plasty in 92 per cent of twenty-three patients so operated upon.

Silfverskiöld[12] transplanted the whole tendon radially at the level of the metacarpophalangeal joint of the thumb; or, the tendon may be translocated (von Baeyer).

The Steindler operation may create a flexion contracture of the end phalanx of the thumb. Correction of this contracture by z-lengthening of the flexor longus pollicis and anterior capsulotomy of the interphalangeal joint ended in gangrene of the thumb in one case, in which a basal rotational osteotomy of the first metacarpal bone was also done to carry it forward. An artificial thumb of plastic material[13] was

the thumb (Baldwin operation[14]) is an operation the indication for which must be carefully made. The thumb is fused in the position for grasping. The keystone block of Allen and Thompson[15] seems a better way to hold the thumb in a grasping position, a block of bone between the metacarpals of the thumb and index finger holding the thumb rotated.

Rotation osteotomy of the base of the first metacarpal may carry the thumb forward but recurrence seems likely because the kinetic factors producing deformity are not overcome.

Certain experimental operations were worked out for relief of thenar palsy, which have not been tried clinically. They have limited application even theoretically but may be interesting to those who are interested in hand surgery. The author worked with Dr. Charles Sutro on an extra-articular posterior bone block of the carpometacarpal joint of the thumb to prevent the falling back or posterior displacement of the first metacarpal bone. The operative area is small and the bone graft has insecure anchorage. The transference of the

oblique adductor of the thumb to the radial tubercle of the proximal phalanx of the thumb may be of use in median nerve

FIG. 13. A, intrinsic arthritic contracture of the fingers. The appearance of the hand at the first operation. The iodine-colored hand is lying on sterile drapes. The proximal inter-phalangeal joint showed only a trace of active flexion.

FIG. 13. B, a photograph taken in the operating room of the shortened collateral extensor tendons of one finger. They were lengthened in z-manner and the ends sutured to each other by a black stitch.

paralysis. In 1937, experiments were made on the transfer of the flexor sublimis of the index finger and its attached lumbrical to the thenar insertion.

The Bunnell operation was modified experimentally, two free tendon grafts being attached to the motor. One tendon
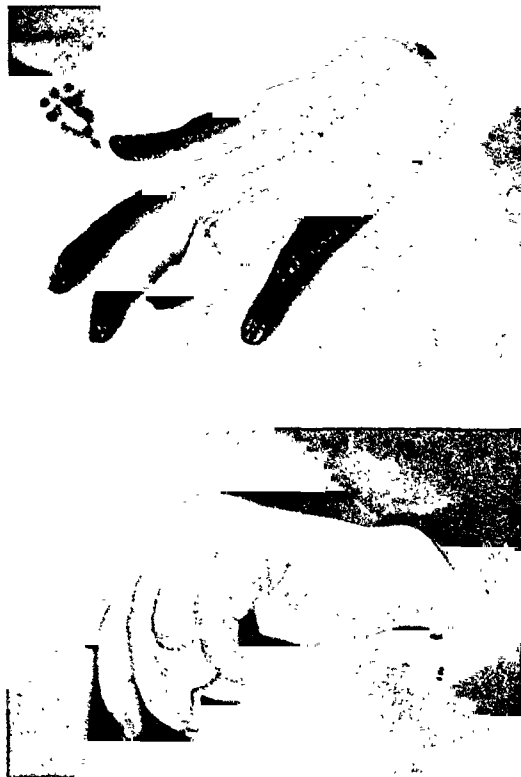
FIG. 13. C, the opening and closing of the hand about a month postoperatively. (The operations were done between January 31st and February 26, 1936.) The dressing covers a silk stitch abscess of the ring finger. This improvement was not maintained because the patient did not co-operate in postoperative care.

graft was attached to the normal insertion of the thenar muscles, and the other to the distal part of the first metacarpal, the intent being that the function of the opponens and short abductor of the thumb be each replaced. On pull of the motor, inequality of tension was noted in the grafts. A fascial tube, attached to the motor, was also used rather than a free tendon transplant. Finally, a fascial loop was passed about the first metacarpal and attached to the fifth metacarpal, an operative procedure which can be used to place the totally paralyzed thumb in a grasping position. In the paralytic hand, whose thenar muscles and finger flexors are paralyzed, but whose hypothenar muscles and little finger flexors are good, the little

finger may be made into a thumb by a
rotation osteotomy of the base of the fifth
metacarpal bone. It may be necessary to
lengthen the web between the fourth and

wristlet,[17] the purpose of which is restora-
tion of the relaxed carpal arch by com-
pression of the wrist for more advantageous
thenar and flexor muscle power.

FIG. 14. A spastic hand is seen in the upper left photograph before injection
of the ulnar nerve at the level of the wrist by Dr. Milgram. The index and
little fingers are in the intrinsic position, the middle and ring fingers in
extrinsic flexion. Muscle action upon the fingers is therefore dissociated.
The thumb is drawn into the palm and lies between the index and middle
fingers. The wrist is palmarly flexed, a position less favorable to the de-
velopment of intrinsic finger position or contracture. The other photo-
graphs were taken after injection of novocain about the ulnar nerve. The
fingers become clawed and the thumb is out of the palm.

fifth fingers. The patient would then have
two right hands or two left hands, depend-
ing on which hand is operated.

Lauenstein,[16] in 1880, osteotomized the
bases of the second and fifth metacarpals
in complete loss of the thumb.

*Leather Strap to Hold the Thumb Opposed
or Abducted.* An inexpensive and simple
leather strap was made to hold the thumb
either in opposition or in abduction. The
strap has a loop at one end which is placed
about the base of the thumb. The thumb
is opposed by pulling on the loop. The
strap is placed about the hand from palmar
to dorsal and then palmar again, where it
is buckled to itself under appropriate ten-
sion. This placing of the strap is reversed
for abduction of the thumb. Movements of
the fingers are not interfered with.

This strap differs from the Goldthwaite

DISABILITIES OF THE ADDUCTOR MECHANISM
OF THE THUMB—ADDUCTION AND PSEUDO-
ADDUCTION DISABILITY OF THE THUMB
—THE SEQUELAE OF ROTATION OF
THE THUMB, POLLEX VALGUS AND
ULNAR SESAMOIDITIS

Adduction of the thumb is an ulnar
movement of the thumb in the plane of the
hand by action of the first dorsal inter-
osseous muscle and the oblique and trans-
verse adductor pollicis muscles. The thumb
is abducted by the abductor longus pollicis
and the extensor brevis pollicis in the same
plane. The extrinsic muscles balance the
intrinsic adductor muscles in this uni-
planar lateral movement.

The adductor muscles also balance the
thenar muscles. The latter inserting on
the radial tubercle of the base of the first

phalanx of the thumb, tend to rotate the thumb volarly. This rotation movement is counterbalanced by the adductor muscles

abducted or opposed completely. This is easily tested by comparing spread of thumb and index finger on each side and
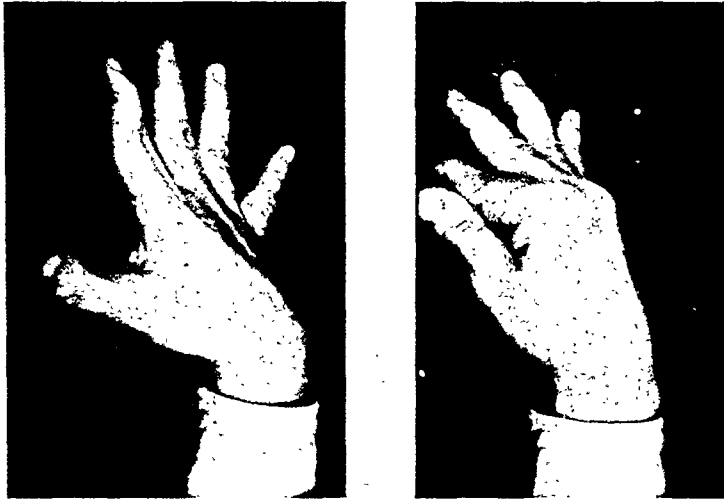

Fig. 15. Extensor variant positions of the fingers. A, *the spastic hand:* The left photograph shows the attempt at common (extrinsic) extension, the movement being carried out in palmar flexion of the wrist. The fingers, particularly the index fingers, show flexion of the distal joint and hyperextension of the proximal joint. Note the prominence of the two extrinsic extensor tendons over the dorsum of the proximal phalanx of the index finger. The right photograph shows the hand when the patient tries to put the fingers into the intrinsic position. There is lesser flexion of the distal joints, the thumb is drawn somewhat into the palm, and there is lesser palmar flexion of the wrist. The extensor variant deformity is present in both positions, extrinsic and intrinsic, of the fingers.

Fig. 15. B, *the paralytic band:* This case is described in the text.

which insert on the ulnar tubercle of the same phalanx.

Adduction contracture of the thumb is not uncommon. The adductor muscles are shortened so that the thumb cannot be

by opposition of each thumb. The palmar fibers of the adductor muscles may be most shortened. The fascia contracts, especially the sharp edged fascia beneath the web. The web itself becomes smaller

but it is not necessary to lengthen it after adductor tenotomy and fasciotomy.

The adduction contracture is often only a part of a complicated hand disability. The fingers may be clawed, in neutral position or in intrinsic position.

In the spastic hand, it is more likely that the adduction contracture will be a part of a more or less diffuse spasticity in

FIG. 15. C, *the arthritic hand:* All the joints of this extremity were involved.

FIG. 15. D, hyperextension of the proximal joint of the index finger after laceration of its flexor tendons. Flexion of the metacarpophalangeal joint is by interosseous action. The distal joint is extended and there is no extensor variant deformity.

the region of innervation of the motor branch of the ulnar nerve. Or, the spasticity may be uneven, greater in the thumb or in the fingers. This contracture is sometimes seen in radial or posterior interosseous nerve palsy by imbalance between the adductors of the thumb supplied by the ulnar nerve and the paralyzed ab-

ductor longus pollicis supplied by the radial nerve. Sometimes in ulnar nerve palsy, the web of the thumb and the fascia of the paralyzed adductor muscles become tight, so that a mild adduction contracture exists. The arthritic hand occasionally shows adduction contracture, especially in arthritis of the carpometacarpal joint.* The traumatized hand may show this contracture as a result of direct local trauma or of improper splinting. Clawing of the fingers by ischemic contracture is sometimes associated with adduction contracture of the thumb. An untreated chip fracture of the radial tubercle of the basal phalanx of the thumb may give similar contracture. It is possible to have an adduction contracture as an end result of infection of the hand. The association of adduction position or contracture with the extrinsic deformity of the thumb has been discussed.

It is only the severer forms of this contracture which held operative relief. The technic of this operation has been described and its use in the relief of spastic adduction contracture.[18,19] This operation was used in five cases for the relief of adduction contracture by other cause. The adduction contracture of the thumb in claw hand after trauma or infection is corrected

* It is pertinent to point out that adduction contracture of the thumb may follow arthritis of its carpometacarpal joint, the intrinsic deformity arthritis of its metacarpophalangeal joint, and the extrinsic deformity arthritis of its interphalangeal joint.

by a release of all the tight structures, a pedicle graft covering the area of skin defect (Mayer).

the man whose extrinsic thumb deformity was corrected at the same time adductor section was done. In the fifth man, adduc-

Fig. 15. E, extensor variant deformity of the index and middle fingers. The index finger is ankylosed at its interphalangeal joints as a result of an old infection. The flexor tendons of the middle finger had been cut many years before examination.

One man had an infection of the forearm after a bullet wound with resulting ankylosis of the wrist and elbow. The adduction contracture followed improper splinting. The second man had a paralysis of the posterior interosseous nerve following a bullet wound, and the contracture was in part due to imbalance of power between the adductors and the paretic long abductor of the thumb, and in part to a second bullet wound which entered the dorsum of the hand near the head of the first metacarpal and made its exit on the thenar eminence. The third man, wounded in the region of the left antecubital fossa by an explosive bullet, had a thick scar in this fossa, which bound down its structures. There was no definite nerve palsy, and the clawing of his hand, and flexion deformity of his wrist were considered ischemic in character. The radial nerve had been explored and it is possible that the adduction contracture of the thumb was due in part to imbalance between the adductors and extrinsic abductors of the thumb. The fourth case is that of

tion contracture of the thumb followed improper splinting of the hand, after operation for a complete avulsion of the flexor tendons of the index finger.

In all five cases, adductor section was one of a number of operations done. In two, wrist fusion and adductor section were done simultaneously.

(Wrist position influences abduction and adduction of the thumb. In full dorsiflexion, abduction of the thumb is strained while the thumb moves more freely when the wrist hangs in palmar flexion. Strongest action in abduction and adduction occurs in the neutral position of the wrist, that is, in some dorsiflexion, and it is in that position that the wrist is usually stiffened. The wrist should not be arthrodesed in full dorsiflexion, for this position will not give maximal thumb and finger power.)

It is not to be expected that release of adduction contracture will give a free range of abduction and adduction. The power of adduction is not lost after operation. The end result is dependent not only on proper

operative release but also on adequate post-operative physiotherapy. The result of this section was good in the first man. In the second and third, follow-up was inadequate to determine the end result. The follow-up was long in the fourth case with some improvement in abduction and opposition. The last man showed good improvement in abduction two weeks after operation but has not been seen since.

It is necessary to amend the statement that the adductor muscles reattach themselves to their usual point of insertion. This does not seem to be so.

PSEUDO-ADDUCTION CONTRACTION OF THE THUMB

In opposition contracture of the thumb in spastic paralysis, in median nerve predominance in a hand whose radial or ulnar nerves are paralyzed, in arthritis or otherwise, the web of the thumb and the adductor muscles become shortened *secondarily*. The first metacarpal bone is immovably opposed between the index and middle fingers and the carpometacarpal joint of the thumb is contracted volarly. The thumb itself is usually in the palm, but need not be, for it may show fixed extrinsic deformity or unusual rotation.

This is not a true or primary adduction contracture, since it is not a contracture in the plane of the hand. It is a pseudo-adduction contracture of the thumb by thenar muscle (and hence, median nerve) predominance in a plane anterior or volar to the hand.

Adductor section alone will not correct this deformity. Section or stripping of all shortened structures is necessary and this means thenar muscle stripping plus volar capsulotomy of the carpometacarpal joint of the thumb. The metacarpophalangeal joint of the thumb may also need capsulotomy.

SEQUELAE OF ADDUCTION CONTRACTURE AND ADDUCTOR SECTION

Rotation of the Thumb. Volar rotation of the thumb by pull of the thenar muscles

has been observed after adductor section since the counterbalancing force of the adductors is lost. The nail of the thumb faces more volarly. This rotation was slight in the one case in which it was seen and did not disturb function of the thumb.

Such volar rotation of the thumb may develop spontaneously in pseudo-adduction contracture of the thumb by pull of the relatively stronger thenar muscles. Two such instances were seen. In one man, it followed the development of this contracture after ulnar and posterior interosseous nerve palsy. An extreme degree of such rotation was observed in a spastic hand, the deformity of which is pictured before and after its correction.

Dorsal rotation of the thumb has not been noted after thenar stripping. It is possible and should be looked for, not only after this operation but also in the hand showing imbalance of muscle power between the median and ulnar nerves in favor of the latter.

POLLEX VALGUS AND ADDUCTION CONTRACTURE OF THE THUMB

Pollex valgus deformity is a rare sequel by adductor pull after thenar muscle stripping or after injury to the region of insertion of the thenar muscles. The thumb becomes deviated ulnarly with reference to its metacarpal. Valgus deformity has not exceeded 10°. The extensor longus pollicis may maintain or increase this valgus secondarily.

In long standing valgus, a mild secondary adduction contracture of the thumb develops. A mild flexion contracture of the metacarpophalangeal joint may also be present coincidentally by shortening of the thenar muscles or by contracture of the volar capsule of the metacarpophalangeal joint of the thumb.

Pollex valgus was seen once in a spastic hand after stripping of the thenar muscles. Two other instances have been observed. A boy of fourteen had a supernumerary thumb removed as a child. The incision was placed as the incision for thenar

stripping. A valgus deformity of the left thumb was now present with radial prominence of the first metacarpal head. The extensor longus pollicis tendon was angulated making an obtuse angle ulnarly. Action of this tendon increased valgus of the thumb. The thumb could not be brought to neutral position. Slight limitation of flexion was present at its metacarpophalangeal joint as well as a mild adduction contracture. The hand was otherwise normal. He was able to oppose, although the opponens muscle was a little atrophic, and to extend and abduct the first metacarpal bone.

A man of thirty-seven had injured each thumb as a child. As a school boy, he used to run precipitously down the school steps, and he struck the radial side of each thumb against a wall on several occasions. This side of the thumb was large and sometimes swollen. He recently complained of pain over the ulnar sesamoid of the right thumb, so that it became difficult to lift bundles.

Each thumb showed a radial prominence of the first metacarpal head and valgus of the thumb, more marked on the right side. A mild adduction contracture of the right thumb was present. There was very marked tenderness over the apparently enlarged ulnar sesamoid of the right thumb. He could not extend the metacarpophalangeal joint of the thumb fully. The roentgenogram of the right hand showed an old ununited chip fracture in the region of the radial aspect of the base of the proximal phalanx, at the site of the thenar muscle insertion. Soft tissue swelling was present at this site. The thumb showed a pollex valgus deformity of 10° and a flexion position of 170° at the metacarpophalangeal joint.

The chip fracture caused relative weakness of the thenar muscles so that adductor predominence gave first a pollex valgus deformity, then a mild adduction contracture, and lastly, ulnar sesamoiditis by occupational strain. It should be remembered that the ulnar sesamoid of the

thumb is placed in the tendon of insertion of the adductor muscles.
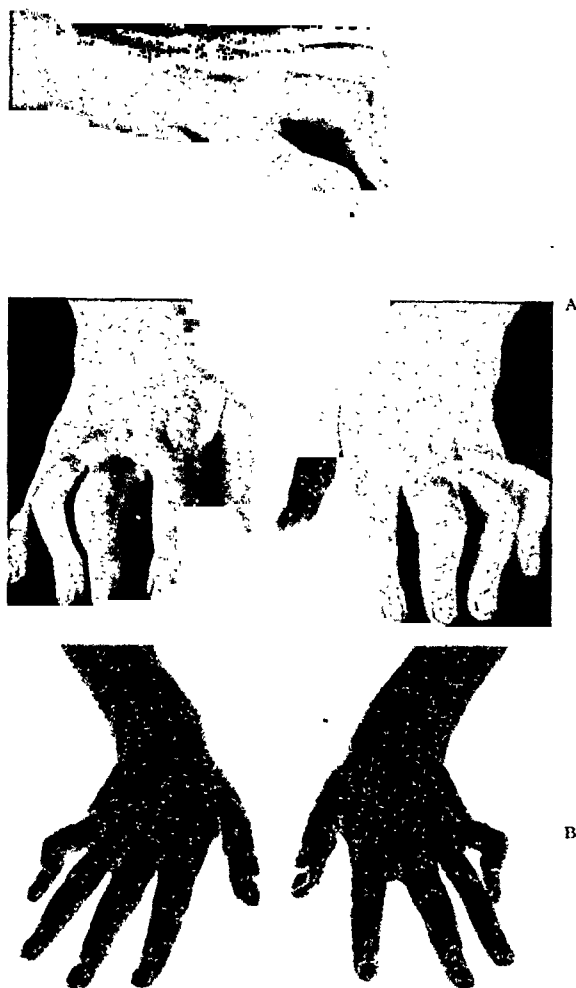
Ulnar sesamoiditis is a late sequel of

Fig. 16. A, *flexor variant deformity:* The arthritic hand, showing both flexor and extensor variant deformities of the fingers. B, flexor variant deformity in each fifth finger, which shows congenital flexion contracture of the proximal interphalangeal joint.

adduction contracture. Enlargement and tenderness of the ulnar sesamoid was also noted in two other cases, that of a man with posterior interosseous nerve palsy, and in a woman with arthritis of the carpometacarpal joint of the thumb.

PARALYSIS OF THE ADDUCTOR MUSCLES

Adductor paralysis is seen in infantile paralysis and in paralysis of the ulnar nerve or of its motor branch. The power of adduction of the thumb is not necessarily lost, given a strong extensor longus

pollicis, whose tendon shifts medially on each substitutionary adduction movement. This substitutionary power is necessarily weaker than normal adduction.

No operation had yet been devised to replace the paralyzed adductor muscles nor is such an operation usually needed.[*,20]

OTHER DISABILITIES OF THE ADDUCTOR MECHANISM OF THE THUMB

Traumatic Atrophy of the Adductors of the Thumb with Interosseous Muscle Contracture in Abduction and Adduction by Diagonal Palmar Force. This is a unique case, worthy of detailed record:

CASE V. G. J., a Greek wrestler of twenty-four, was hit on the palm of the left hand by the night stick of a policeman, more than six years before examination. He turned his left arm out and back to protect his back. The palm received the force of the blow, direction of force being diagonal, between thumb and fingers. The hand was acutely painful and soon became swollen and ecchymotic. He could not move the thumb for almost a week. After three weeks, he could again use his thumb, even in adduction. He wrestled professionally for four months and during this period, he also worked as a counterman in a restaurant.

In the fifth month after his injury, his hand became so weak that he began dropping things. He was unable to pick up a small light thing. He was usually unable to lift a pound weight. The weakness seemed one not only of the hand but also of the wrist. There was occasional dull ache in the hand on effort. He now noted an unnatural hollow in the interspace between the thumb and the index finger.

A deep hollow was seen in the first dorsal interspace of the left hand. The first dorsal interosseous muscle and the adductors transversus and obliquus were absent. On palpation, the fragment of the adductor transversus was felt near the head of the second metacarpal bone, and the thin tender remainder of the adductor obliquus near its base. The meta-

* Bunnell, since this was written, used a tendon loop operation to restore thumb adduction, the motor being the extensor communis tendon of the index finger. The tendon was prolonged by a tendon graft passed subcutaneously to the palm of the hand about the ulnar border of the hand and attached to the ulnar tubercle of the thumb's proximal phalanx.

carpal origin of the first dorsal interosseous muscle was not tender. He could adduct the thumb with a little power by means of the extensor longus pollicis, although the tendon shifted medially with a slight sound as it adducted the thumb. The adducted thumb was easily forced into abduction.

Flexion of the metacarpophalangeal joint of the thumb was limited to 115°. The flexor longus pollicis was weak. Extension of the thumb was good. The slightly atrophied thenar muscles were weak, and although opposition was possible, he could not bring the thumb to the little finger. Active abduction of the thumb was weaker than normal.

Flexion and extension of the fingers were good, except for weakness of little finger flexion. There was hypothenar atrophy. The sinking-in of the dorsal intermetacarpal spaces indicated obvious dorsal interosseous muscle atrophy. The more unusual thing was the visible evidence of volar interosseous muscle atrophy in the palm. Intrinsic adduction of the fingers was weaker than normal. There was maintained intrinsic adduction position of the index finger, indicating fair power in the first volar interosseous muscle. He could not abduct the index finger intrinsically. The fifth finger was held in intrinsic abduction contracture by a strong abductor digiti quinti brevis muscle.

The grip of the hand was weak. He could not use the hand for detailed or skillful movements.

MEASUREMENTS OF THE HAND

Circumference at	Left Hand, Inches	Right Hand, Inches
1. Metacarpal heads.....	7⅞	7⅛
2. Palm	7⅝	8½
3. Thenar region, thumb in abduction..........	9	10
4. Wrist............. ..	6⅞	6⅞

Analysis of this hand indicated a general weakness of the intrinsic muscles, including the special muscle groupings of the thenar and hypothenar eminences. Some of the extrinsic muscles were weak, particularly the flexors of the thumb and little finger.

The complete absence of the adductor mechanism of the thumb was in part compensated for by an adductor action of the extensor

longus pollicus. The first dorsal interosseous muscle lacked both its functions and an intrinsic adduction contracture of the index finger followed by imbalance between it and the first volar interosseous muscle. A more unusual finding is the intrinsic abduction contracture of the fifth finger by greater power of the abductor of the little finger over the weak third volar interosseous muscle.

Operation was recommended but the patient refused. The operative plan included three distinct operative procedures: a fascial plastic to reattach the adductor remains to their normal insertion, an extensor plasty of the index finger to restore its first dorsal interosseous muscle action, and lastly, proximal stripping of the tendon of insertion of the abductor digiti quinti brevis muscle.

ADDUCTOR AND FIRST DORSAL INTEROSSEOUS MUSCLE STRAIN

Interosseous muscle strain is described elsewhere but the following case is worthy of note because the force creating disability was like that of the preceding instance:

CASE VI. A man struck the palm of his hand against the floor in a fall, the direction of force being diagonal between thumb and index finger. The first dorsal interspace was swollen and there was tenderness over the adductor muscle group. Tenderness was most marked over the point of insertion of the first dorsal interosseous muscle. Pain was increased when the tendon of insertion was stretched, when the index finger was forced into intrinsic adduction. Abduction of the thumb was painful by stretching of the adductors.

Occupational injury may also strain the adductor mechanism of the thumb, making painful not only adduction of the thumb, but intrinsic radial abduction of the index finger.

A case report (Case VII) by Stewart[21] indicates that a rupture of the adductor muscles is possible by a compressing force:

CASE VII. An ice worker caught his left hand between two blocks of ice. The mass of muscle which protruded through a laceration in the web between thumb and index finger was the adductor pollicis, completely detached from its origin but still retaining its tendinous insertion. The herniated muscle was resected close to the insertion. A satisfactory restoration of thumb function was said to have been attained.

DISABILITIES OF THE HYPOTHENAR MUSCLES

Hypothenar muscle disability is not common. It is reflected in little finger dysfunction. The hypothenar mass has its proper flexor and abductor muscles, and an opponens muscle. Because the little finger is bound to the ring finger in the plane of the hand, hypothenar muscle disability is not very important, nor comparable with thenar disability.

In the athetoid hand, the hypothenar muscles are in constant spasm, drawing the little finger forward in a sort of opposition. The cup of the palm deepens, accenting the mass of the hypothenar muscles. The little finger, now held in intrinsic flexion and abduction, soon claws and there is tireless alternation of the finger between these two positions.

However, contracture in the intrinsic position of flexion-abduction does take place in the spastic hand. *Spastic or dystonic crossing of the little finger* over or under the ring finger is sometimes seen. The ring finger for instance, is held in intrinsic ulnar adduction over the extrinsically flexed little finger, or the reverse may be true.

The disability of the spastic hypothenar muscles is never isolated but is only a part of the greater picture of spasticity.

The hypothenar muscles are not infrequently paralyzed in infantile paralysis and ulnar nerve paralysis. In both, a clawing of the little finger takes place, given common extensor power, not only because of paralysis of the flexor brevis and abductor brevis of the little finger but also because of the usually associated lumbrical paralysis. An abduction position of the little finger (by action of the extensors of the little finger) is considered to be an early and frequent sign of ulnar nerve palsy.[22]

Traumatic contracture in the intrinsic flexion abduction position was seen twice. The bony borders of the carpal canal

to scalenism alone but to any lesion causing loss of hypothenar power. It needs the confirmation of more experience.
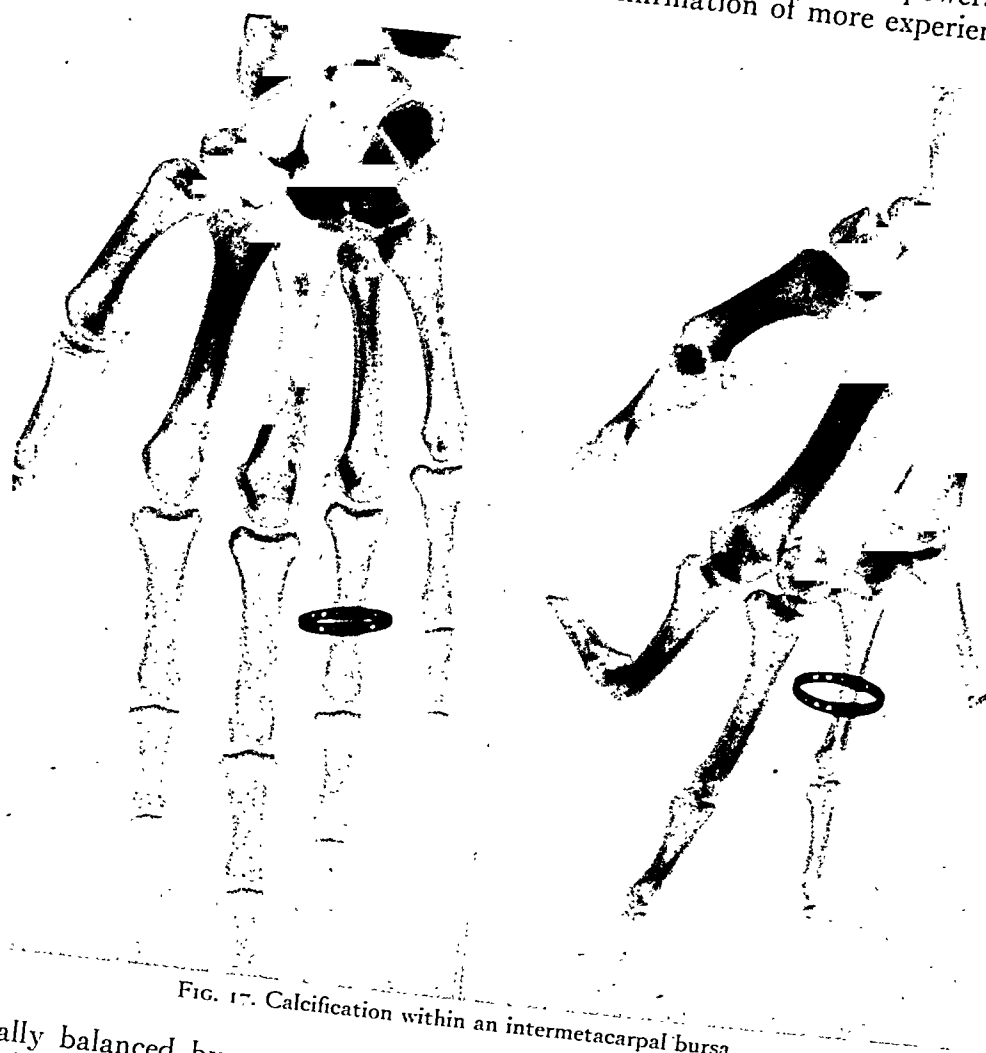

Fig. 17. Calcification within an intermetacarpal bursa.

are normally balanced by an equality of thenar and hypothenar muscle pull. Kinetic imbalance between thenar and hypothenar muscles in favor of the former may cause rotation of the scaphoid bone volarly. Such imbalance may be seen in scalenism, in that the muscles of the hand supplied by the median nerve have a relative or actual predominance over the muscles supplied by the ulnar nerve.

The obliquely directed fibers of the thenar muscles pull on the tuberosity of the scaphoid through the agency of the transverse carpal ligament.

This theory is not meant to be restricted

EXTENSION DISABILITIES OF THE FINGERS—INTRINSIC EXTENSION DEFORMITY OF THE FINGERS

The intrinsic muscle mechanism of the finger balances common flexion and common extension. When this mechanism is dominant, the finger is flexed at the metacarpophalangeal joint and extended at the proximal and distal interphalangeal joints. The index finger is more often on a higher level than the other fingers. The sharp edge of the extensor aponeurosis of the dorsum of the first phalanx may be palpated.

The hand cannot grasp adequately because of this deformity, which is either mutable or fixed.

It is seen in three of the four groupings of hand disabilities, the spastic, arthritic, and in the traumatized hand, but not in the paralytic hand since the intrinsic muscles are usually paralyzed.

This deformity in the spastic hand means hyperinnervation in the distribution of the motor branch of the ulnar nerve, so that adduction position or contracture of the thumb is not infrequently a part of deformity. The intrinsic position is either constant, irregularly alternating, or dissociated, as in the athetoid hand. The "pill roller" hand adequately expresses the conception of fixed deformity.[23]

The arthritic hand not infrequently shows fixed intrinsic deformity, with or without adduction contracture of the thumb, or intrinsic deformity of the thumb; or, one or more fingers may only show intrinsic dominance.

Laceration of finger flexor tendons does not immediately give hyperextension deformity. It may or may not develop some time after tear. If the two flexor tendons are functionless, the balance of power passes to the extensor side, and the proximal and distal interphalangeal joints are held in extension. This extension is more intrinsic than extrinsic, for the metacarpophalangeal joint flexes when the flexion effort is made by interosseous muscle action. The extensor rebounds are strong and there are no flexor rebounds. The finger is out of the palm when the fist is made, but can be passively flexed if there is no contracture. Yet, synergistic flexion of such a finger was once seen. If the flexor profundus is intact, the extensor variant deformity may follow. It is, however, more usual that, when the sublimis tendon is torn, the profundus tendon is also torn or bound by adhesions.

The surgery of the intrinsic extensor mechanism is delicate and the end result dubious, but Bunnell's work may point

the way to better result. Such surgery may be by-passed.
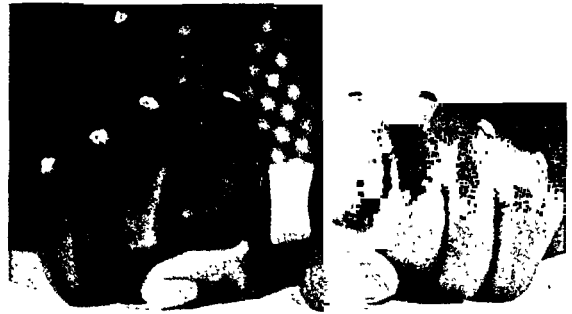
Test injection of the ulnar nerve by

Fig. 18. The fourth and fifth metacarpal heads are depressed in the right hand. This is not an unusual finding in the hypotonic hand, the ulnar half of which shows relaxation. In this case, interosseous muscle imbalance was due to obscure scalenism and relieved by scalenotomy, with better postoperative alignment of the knuckles.

novocain in the lower forearm or of its motor branch between the hamate and pisiform allows preoperative estimate of reversal of finger position in the diffusely and evenly hyperinnervated spastic hand or fixed arthritic hand. If reversal to claw position is complete, resection of the motor branch is not indicated; if, however, there is incomplete reversal to a more neutral position of the fingers, given capsular contracture of the phalangeal joints, then it is indicated. Alcoholization of this nerve may be indicated instead of resection, but it is an operation of compromise within the limited field of incomplete reversal of the finger whose phalangeal joints are only slightly contracted. Resection of the motor branch of the ulnar nerve, introduced by Steindler,[24] is probably best indicated in the fixed intrinsic deformity, either spastic or arthritic. A similar operation is used for the correction of fixed intrinsic deformity of the foot, the motor branch of the lateral plantar nerve being resected.[25]

In two cases, section and stripping of the collateral extensor tendons were done, once in a mutable spastic hand with intrinsic dominance and once in a fixed arthritic hand. In the spastic hand, it was

observed that intrinsic extension diminished progressively to the little finger. It was decided to resect the collateral

phalangeal joint, and if it is not sectioned transversely, an extensor variant deformity follows. This did happen in the index
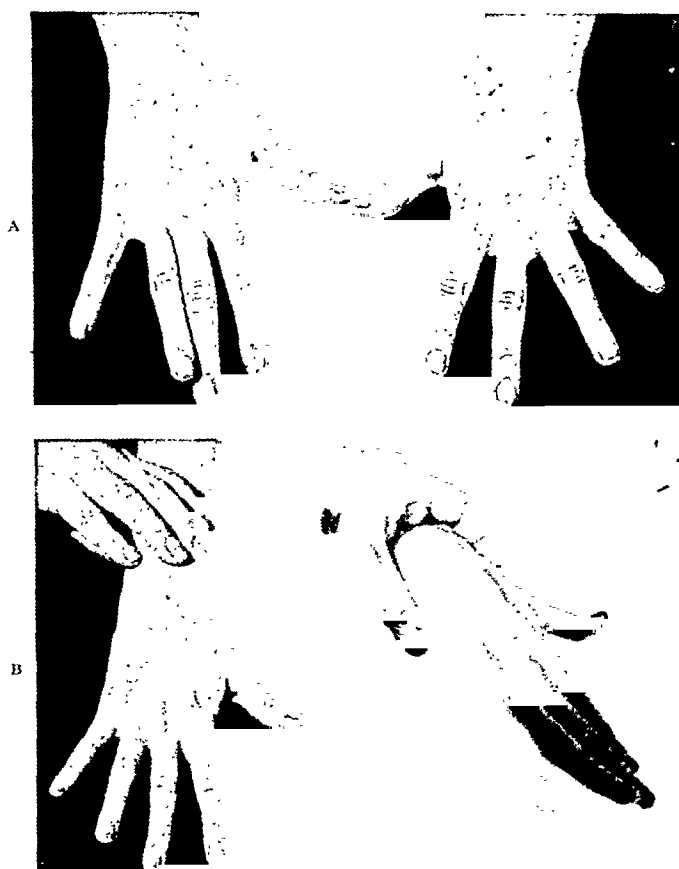

Fig. 19, A, the ring finger is radially abducted by weakness of the fourth dorsal interosseous muscle, a preoperative photograph taken January 9, 1939. B, after extensor tenoplasty, the ring finger can be ulnarly abducted. A postoperative photograph taken May 19, 1939.

extensor tendons only in the index and middle fingers, for it was believed that reduction in spasticity of these fingers would diminish spasticity of the ring and little fingers by a sort of sympathy in which reduction of spasticity at one point lessens adjacent spasticity. The tendons are approached by radial and ulnar oblique incisions over their course, the incisions beginning just proximal to the distal interphalangeal joint and ending at a point just proximal to the proximal joint. The common extensor tendon is an important factor in the maintenance of intrinsic extension deformity of the proximal inter-

finger and secondary transverse section of the common extensor tendon was necessary. It need not be feared that common extensor power will be fully lost, for the tendon can only slip proximally a short distance in its binding extensor aponeurosis. The operation gave flexion position of the index finger, especially sublimis flexion. Ultimately, there was only slight improvement in passive grasping, the fingers being usually held in flexion position. Active extension was slight.

Three factors contributed to the fixed intrinsic finger deformities of the arthritic hand: a tight common extensor tendon,

contracted collateral extensor tendons, and shortened collateral ligaments of the proximal interphalangeal joint. The deformity could be passively corrected only when each of these three structures was released, either by section and stripping, or z-lengthening. The immediate result was fairly satisfactory but the late result was not, since the patient received no postoperative physiotherapy and did not co-operate in treatment.

The stripping of the collateral extensor tendons seemed to give a little better result than the z-lengthening. Slight recovery of extensor power of the distal phalanges was observed after either procedure, and an extensor rebound was elicited in the finger in which the collateral tendons were stripped because they were sutured to the common extensor tendon.

Resection of the motor branch of the ulnar nerve is simpler and should be more efficacious. In either operation, it must be made certain that there is no active arthritic inflammation of the phalangeal joints.

DEFORMITY OF THE FINGER BY COMMON EXTENSOR DOMINANCE

A form of common extensor dominance is considered here in which there is extension of all three phalangeal joints. The common extensor tendon can extend the distal two phalanges when the finger is straight.

There may be extreme voluntary hyperextension of the fingers of the normal hand.[26] The spastic hand sometimes shows extension of the three phalangeal joints as a mutable deformity. The hand with diffuse common extensor dominance may show volar depression of the metacarpal heads and arborization of the fingers.

Postoperative extension contracture of the paralytic finger is seen after the suture of the intrinsic extensor apparatus to the common extensor tendon.

CASE VIII. Sylvia U., a girl of seven and a half, with an infantile paralysis so extensive

that she was never able to stand or to walk, showed the not uncommon paralysis of the small intrinsic muscles of the hand. The left

FIG. 20. Congenital hypertrophy of the first lumbrical muscle.

hand is the one which concerns us. The left wrist was in neutral position and the fingers of the left hand were clawed.

Traction extended the fingers but maintenance of the correction achieved was not possible.

Dr. J. E. Milgram suggested that extension of the second and third phalanges might be attained by common extensor action. A somewhat similar idea was used by von Hacker[27] to repair a traumatic defect of the common extensor tendon of the index finger. The proper extensor of the index finger was cut transversely at the level of the metacarpophalangeal joint, reflected distally and made to insert on the end phalanx. Its proximal stump was joined to the stump of the common extensor tendon at the level of the metacarpophalangeal joint.

Operation was done on one finger on February 3, 1937. The proximal interphalangeal joint was stretched to overcome flexion contracture. A mid-line incision, which began about one-half inch proximal to the metacarpophalangeal joint and extended to the distal interphalangeal joint, exposed the en-

tire extensor apparatus. (This incision is open to criticism since the tendon underlies the incision.) The extensor apparatus over the second phalanx was thin and atrophic. It was freed, sutured to itself, and then to the freed common extensor tendon by two black silk sutures. The extensor tendon was split and an ulnar strip reflected distally and sutured to the extensor mechanism of the second phalanx, in order to re-enforce it. The finger was splinted in extension at all its joints.

Extension contracture of all three joints of the finger followed this operation. This was considered worse than the original clawing, since the finger could not be placed for grasping. A strap was made to hold the finger bent and exercises in flexion begun.

A month after operation, the proximal interphalangeal joint was held in 10° of flexion, and the distal interphalangeal joint in full extension. By extending the finger at the metacarpophalangeal joint, she extended the interphalangeal joints. These showed no independent motion in extension indicating that the common extensor tendon now acted upon its new insertion point on the distal phalanx.

It was noted in September, 1938, that the extension contracture of the finger had been overcome. She was able to flex the finger to 90° at the proximal interphalangeal joint. The distal two phalanges could not be extended and the transplant was reckoned as a failure.

The wisdom of the normal double extensor apparatus is demonstrated in this case. Even if the operative plan had succeeded, it could not have duplicated the coordinated and yet independent actions of the double extensor apparatus.

Relaxation of the radial half or border of the paralytic hand is sometimes seen, whose common extensor strength is greater than its common flexor strength. Relaxation of the ulnar border of the hand is most often hypotonic.

PARALYSIS OF THE COMMON EXTENSOR MECHANISM

When the common extensor tendons are paralyzed—and this is noted in radial nerve palsy and infantile paralysis—the fingers cannot be extended at the metacarpophalangeal joints, but can be extended at the proximal and distal interphalangeal joints. In radial nerve palsy or after suture of a torn radial nerve, extension of the distal phalanx of the thumb may be by intrinsic action rather than by action of the extensor longus pollicis.

The treatment of common extensor paralysis by fusion of the wrist with or without flexor to extensor transplant is well known. It would seem unwise to transplant the dorsal interossei to give common extensor function, as Stoffel[28] advised.

The inability to extend one or more fingers by laceration or fixation of the extensor tendons does not concern us here.

OTHER DISABILITIES OF THE EXTENSOR APPARATUS

Congenital anomalies of the extensor tendons sometimes cause disability. This subject is well covered by Pfeiffer's paper.[29]

There may but need not be congenital anomaly of the extensor tendons in congenital shortening of a metacarpal. It is usually the fourth metacarpal which is short.

Congenital hyperextension of the distal phalanx of each ring finger, causes no functional disability.

Luxation of the common extensor tendon at the level of the metacarpophalangeal joint is uncommon.

Two recent papers discuss this subject adequately. Fitzgerald's[30] case, a woman of twenty-two, showed ulnar luxation of the extensor tendons of the index, middle, and ring fingers of one hand due to absence of the extensor aponeurosis over the proximal part of the first phalanx. Strauss'[31] review of the literature and the presentation of his own case show that most cases are traumatic in origin, and that there must be rupture or division of the dorsal capsule of the joint before lateral displacement of the tendon is possible. The radial half of the extensor tendon may also be torn.

It was noted that, after the division of the conjoined extensor tendons in one

case in which the Shaw operation was done, the extensor tendons subluxated ulnarly.

woman's hypotonic hand. After recent use of a paring knife, the tendon slipped radially as the index finger was placed in

A   B

FIG. 21. A, a preoperative photograph (January 13, 1936) of a paralytic claw hand. The extensor tendons are contracting actively. B, a photograph (June 6, 1941) taken about five and one-half years after the Shaw operation. The hand is shown at rest and as the fingers flex.

The congenital form is most unusual. In Levy's case, as described by Mason,[32] the familial occurrence of this luxation is commented upon.

A mother and daughter were seen in whom this luxation seemed congenital and familial.

CASE IX. The extensor tendon of the right middle finger (of Mrs. D. O., forty years old) was displaced ulnarly with audible snap on voluntary, forced, full flexion of the metacarpophalangeal joint, and slipped back into place on extension. Both luxation and replacement of the tendon were easily done and painless, but she noted that repetition of luxation was painful.

Thirty three years before she fell while skating and struck the knuckles of her right hand against the curb. She heard a cracking sound in the hand as she struck it. She had never been treated for this luxation.

Her daughter, eighteen years old, had exactly the same thing. The extensor tendon of the right middle finger dislocated ulnarly when it was flexed passively by the thumb. The beginning of luxation was not known and_she remembered no trauma.

Radial subluxation of the extensor tendon of the right index finger was seen in a

ulnar adduction. The inconstant slipping was not painful.

Luxation of the extensor tendon of the index finger may take place more proximally over the prominent dorsal tubercle of the dorso-ulnar base of the second metacarpal.[33]

Tumors of the intrinsic extensor apparatus are uncommon. Three patients were operated upon. In two, a discrete giant cell tumor was attached to the collateral extensor tendon. In the third, a lobulated tumor, grossly a xanthoma, was adherent at several areas to the collateral extensor tendons, and to the flexor tendon sheath of the middle phalanx of a finger. No tumor caused kinetic disability of the finger.

VARIANT POSITIONS OF THE FINGER

The variant positions of the finger are positions of the finger intermediate to the determinate deformities of the finger— the claw finger and the finger in intrinsic position—by dissociation of extensor power, flexor power or both. The term, variant, is used advisedly, for these finger positions are variants of the determinate deformities.

Extensor Variant. The finger is hyperextended at the proximal joint and flexed at the distal joint. The metacarpophalangeal develop. In this sense, this finger deformity is a derivative or variant of the finger with intrinsic deformity.
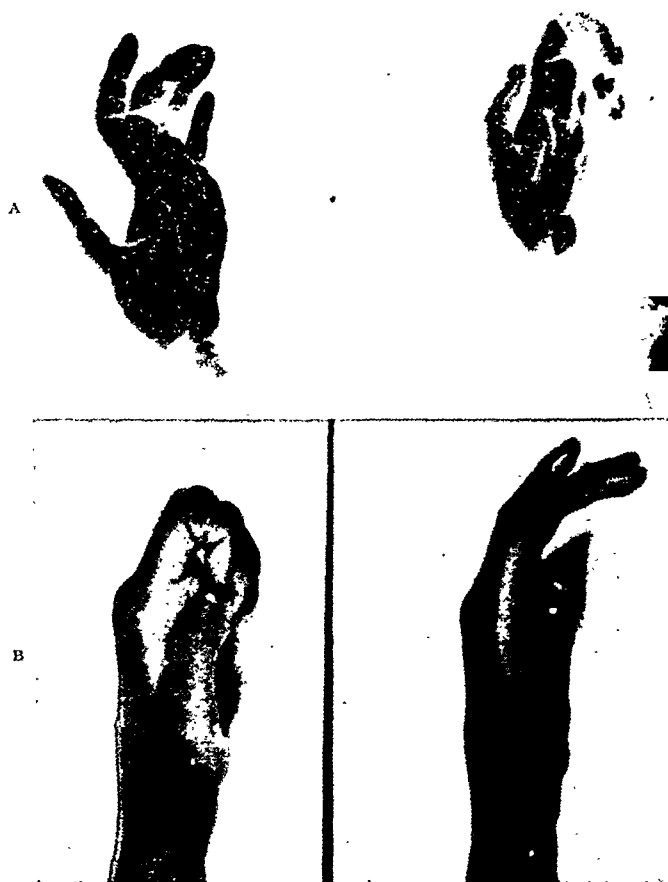

FIG. 22. A, a preoperative photograph (June 14, 1935) of the paralytic claw hand. B, a photograph (July 25, 1941) six years after the Shaw operation. The hand is shown at rest and with the fingers bending actively.

geal joint is in flexion. Attempt to extend the distal phalanx usually causes increase in extension of the proximal joint. The proximal joint may be flexed actively, especially in the milder degrees of deformity and before contracture develops. The finger may sometimes flex with a snap as the common extensor tendon rides radially.

There are two mechanisms which may create this deformity: a weakness of the intrinsic extensor mechanism, or a weakness of flexor sublimis action. Extensor rebound is weak or absent. Were the intrinsic extensors the equal of the flexor profundus, the intrinsic deformity would

The wrist, therefore, is usually in dorsiflexion rather than in palmar flexion.

The flexed distal phalanx tenses the extensor cords. This phenomenon is possible only when all three phalangeal joints are extended, or in the intrinsic position of the finger. The metacarpophalangeal joint may be hyperextended $10°$ or more in the former instance, but it is more usual that this joint is flexed. Forced flexion of the distal joint, the other phalangeal joints maintaining their position, tenses and makes prominent the extensor cords. This maintains or increases extensions of the proximal joint, while a bow string

action of the flexor profundus tendons does the same thing. The ineffectual attempt to extend the distal phalanx can only increase extension of the proximal joint. The anatomic mechanism which causes the extensor variant deformity is the more dorsal placement of the extensor apparatus, particularly that over the first phalanx. This has been confirmed by palpation in a few cases and by operation in one case.

The deformity is often seen after trauma. Kaplan[34] described the type following an injury to the volar surface of the distal two phalanges and pointed out that a tear of the lateral ligaments of the proximal interphalangeal joint took place with gradual retraction of the lateral bands of the extensor tendon dorsally. I have seen only one case of this type.

CASE X.   A boy of nine was seen at the New York Dispensary on May 5, 1941. The day before, he had been struck by a baseball on the volar aspect of the left middle finger. The ball rode the length of the finger to its tip and bent it back.

He had a mild extensor variant deformity of the finger. Extension of the distal phalanx to 175° was possible. Flexion of the finger was free but weaker than normal. The palmar aspect of the proximal phalanx was swollen and tender.

The finger showed flexor weakness, particularly flexor sublimis weakness, with undoubted strain of the anterior part of the proximal interphalangeal joint. Tearing of its lateral ligaments may have taken place. The mechanism of injury seemed to be due to extensor dominance; yet, the flexor profundus could flex the distal phalanx.

The more usual mechanism is one in which there is weakness (by tearing or stretching) of the intrinsic extensor mechanism of the distal phalanx, usually by a sudden flexion injury of the extended distal phalanx. Kaplan says that in those cases in which the flexion deformity of the distal phalanx is not due to avulsion of the extensor tendon, it is due to tear of the collateral extensor tendons and the binding triangular membrane over the mid dorsum of the middle phalanx. This observation

is important but not categoric. A similar observation was made by Kausch[35] who repaired a traumatic tear of the intrinsic

FIG. 23. The photographs illustrate the arthritic hands of a young woman, the deformity of which was due to myositic shortening of the interossei muscles. The acute flexion deformity of the metacarpophalangeal joints did not allow hand opening nor adequate grip. The fingers showed both flexor and extensor variant deformities. The left hand was operated on August 8, 1942, the interosseous muscles of each finger being isolated, sectioned at their insertion and stripped proximally. Five incisions are needed as in the Shaw operation. She is making adequate progress. Resection of the motor branch of the ulnar nerve was not done because of good adductor power of the thumb.

extensor apparatus secondarily. The collateral extensor tendons were undermined and sutured to each other. This repaired the rhomboid defect found at operation and restored intrinsic extension.

An extensor variant deformity may follow the mallet finger and may be more common than is believed. It is the fault of kinesiologic imbalance and faulty treatment may accentuate this imbalance.

The arthritic hand and sometimes the spastic hand show the extensor variant deformity. I cannot state categorically that the extensor variant deformity is always seen in arthritis of the distal interphalangeal joint and the flexor variant in arthritis of the proximal joint. It was seen twice in the spastic hand, once after stripping of the forearm muscles from the internal epicondyle of the elbow, and once after section and stripping of the collateral extensor tendons of the index finger.

It is only in the spastic hand that this deformity is mutable, whereas tendency to fixation is greatest in the arthritic hand.

interosseous muscle. There was a slight increase of lateral play of the proximal joint and the second phalanx was deviated ulnarly a little.
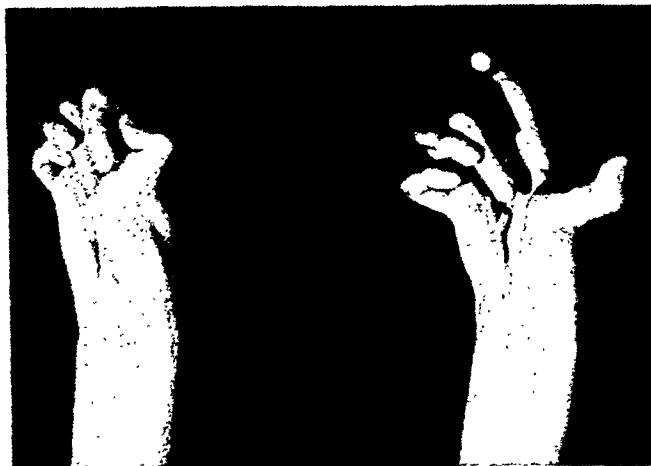

FIG. 24. An unusual deformity of the hand in a young woman, the principal features of which are the extrinsic position of both the thumb and little finger, opposition contracture of the first and fifth metacarpal bones, and loss of flexor function in the third, fourth and fifth fingers. An operative scar is seen in the palm of the hand, the operation being done for the control of secondary hemorrhage in the palm following its laceration by glass. The loss of flexor tendons function may be due either to the operation or to postoperative infection. The unusual position of the thumb and little finger is not caused by improper postoperative splinting, for the hand was not splinted. Scar tissue in the palm holds the thenar and hypothenar eminences in opposition in a hand which showed easy voluntary assumption of the extrinsic position of thumb and finger. This statement is verified by the examination of the normal left hand. Both the thenar and hypothenar eminences showed easy rebound into the position of deformity after passive correction. This is the first instance of *thenar* and *hypothenar rebound* encountered. The patient refused treatment.

I have seen an extensor variant deformity in the paralytic hand only once. It is rare because of the not uncommon association of intrinsic muscle paralysis with finger flexor paralysis.

CASE XI. *Paralytic Extensor Variant Deformity.* The proximal joint of the left index finger of a paralytic girl of ten was hyperextended, while the distal joint was flexed. The metacarpophalangeal joint was slightly flexed. The common and proper extensor tendons stood out as tight bands on the dorsum of the first phalanx. The ulnar collateral extensor tendon was also felt as a taut band.

The finger was also held in intrinsic radial abduction because the first dorsal interosseous muscle was stronger than the first volar

All the fingers closed when she made a fist. Yet, sublimis flexion of the proximal joint of the index finger was only possible as an individual movement, when its first phalanx was held. Extension of the fingers was strong, and the fingers branched in a fanning (extension-abduction) movement, as the metacarpal heads sank more volarly. The distal joint of the index finger could be actively extended but its intrinsic extensor rebound was weaker than its flexor profundus rebound.

The extensor variant deformity was due primarily to flexor sublimis weakness.

In this case, ulnar obliquity of the second phalanx is caused by oblique pull of the extrinsic extensors of the index finger, and not by unequal pull of the collateral

extensor tendons. In the cadaver, such ulnar deviation of the second phalanx may be produced by pull on the ulnar collateral tendon when the radial collateral extensor tendon is sectioned transversely and stripped and when the radial capsule of the proximal joint is cut.

The normal hand may show the extensor variant as a poorly sustained, voluntary motion.

Flexor Variant. The finger is held in flexion of its proximal joint, and hyperextension of its distal joint. The metacarpophalangeal joint is in extension or hyperextension. This deformity is less common than the extensor variant, because, when this position is assumed in the normal finger, passive release of the hyperextension position of the end phalanx snaps the finger into flexion by a fairly strong flexor rebound.

In the normal finger, it is not possible to extend the distal joint actively when its proximal joint is maintained in a given position of flexion.

Two mechanisms of deformity are possible: Isolated tear or injury of the flexor profundus tendon may create this deformity but the flexor variant deformity was absent in the one case seen. The usual cause is weakness of the common extensor mechanism, by open tear or by subcutaneous rupture of the common extensor tendon.

When the triangular membrane is torn in subcutaneous or button-hole rupture, the collateral extensor tendons slip volarly, so that their contraction increases the dominant sublimis flexion of the proximal joint and extends the distal joint. The pull of the collateral extensor tendons is below the transverse axis of the proximal joint so that flexion of this joint is produced rather than extension (Kaplan). This volar displacement of the collateral extensor tendons has been noted by several investigators (Montant and Baumann, Foerster).[36,37]

The flexor variant deformity is noted in the arthritic hand, which may show one finger with the extensor variant deformity and another with the flexor variant deformity. Extension of the end phalanges in the arthritic flexor variant is positional, the pressure of the fingers against bed, table, or other things, pushing the fingers into extension or hyperextension. Sometimes, after passive flexion of the finger, the end phalanx is snapped back into extension with an audible sound because its extensor apparatus, which luxated on passive flexion, snaps back into place.

The extension deformity of the distal phalanx in congenital flexion contracture of the proximal joint of the little finger may be due to the same reason.

The deformity was not seen in the spastic or paralytic hand.

The deformity is comparable in a way to the claw finger, for were the distal phalanx flexed, it would resemble such a finger.

INTEROSSEOUS MUSCLE DISABILITY—DISABILITY IN INTRINSIC FINGER ABDUCTION AND ADDUCTION

The interosseous muscles flex the metacarpophalangeal joints of the fingers and also help extend their distal two phalanges. The first dorsal interosseous muscle is an adductor of the thumb and an abductor of the index finger. The four dorsal interossei are abductors of the fingers. The middle finger, balanced by the second and third dorsal interossei, is the relative axis from which the fingers spread or to which they adduct.

There are needed only three volar interosseous muscles, so that the middle finger has none.

The index finger is balanced by a relative equality of power between the first dorsal and first volar interosseous muscles, the ring finger by the second volar and fourth dorsal interosseous muscles, and the little finger by the third volar interosseous muscle and the abductor digiti quinti brevis muscles. Actually, more muscle power is needed to abduct the fingers than to adduct them and the dorsal

interossei have more bulk than the volar interossei. Clinically, dorsal interosseous atrophy is more often seen than volar interosseous atrophy.

Common extensor abduction of the fingers is secondary to the obliquity of course of these tendons. It should not be confused with interosseous abduction, and the differentiation is easily made. The fingers should be abducted in the intrinsic position to test interosseous abduction and not in extension of the metacarpophalangeal joint. Intrinsic adduction of the fingers is easily differentiated from the adduction of the fingers when they are flexed.

The extensor disability of the finger resulting from disturbance of interosseous balance can not ordinarily be dissociated from similar lumbrical disability. The preservation of lateral movement of a finger or fingers bespeaks interosseous muscle integrity, and hence integrity of its extensor function. If such extensor power be weak in adequate lateral balance of the finger, it may be assumed that either there is dissociation of interosseous power, one part of which is preserved, or that there is absence of power in the lumbricals. This situation is more theoretical than practical, for usually both are synchronously and equally paralyzed. It is difficult then to speak of disability of the hand as of pure interosseous or lumbrical type.

Disability is generalized or localized. In either case, it is expressed by under activity or over activity of the interossei. The finger is deviated either ulnarly or radially in the intrinsic position, if its lateral balance is uneven. General underactivity (weakness or paresis) is most often seen in infantile paralysis and ulnar nerve paralysis. The lumbricals are ordinarily paralyzed at the same time, except for the medial two lumbricals which remain strong in ulnar nerve palsy. Certain neurologic conditions show associated atrophy of the small muscles of the hand, as in amyotrophic lateral sclerosis and progressive spinal atrophy.

The fingers claw, because the balancing mechanism of both lumbricals and interossei is lost, and there is no lateral deviation of the fingers because small muscle paralysis is ordinarily diffuse and even. There may, of course, be unevenness in paralytic interosseous muscle disability.

Weakness of the interossei may follow in the wake of trauma or arthritis. There is obvious atrophy and sinking in of the dorsal intermetacarpal spaces, especially in the arthritic hand. The fingers may be ulnarly deviated at the knobby metacarpophalangeal joints, but this is a postural deviation. In the irritative phase (myositic) of the illness, and in the stage of muscle shortening, the fingers are maintained in the intrinsic position, rather than in the claw position, by the action of the interossei muscles. The arthritic hand may show palmar luxation of the proximal phalanges by interosseous action.

The purest form of general over action of the interossei is seen in the spastic hand, in the region of innervation of the motor branch of the ulnar nerve. Spastic abduction position of the fingers has already been described. The "pill roller hand" is an intrinsic adduction contracture of the fingers and thumb, either arthritic or spastic in origin. There need, however, be no lateral finger deviation. Rarely, the intrinsic muscles become diffusely dominant in a traumatized hand.

Localized disability in intrinsic abduction or adduction of a finger is not common. Isolated weakness of one or more interosseous muscles, while always possible in the spastic, paralytic, or arthritic hand is probable in intermetacarpal bursitis with calcification, in obscure scalenism, and after trauma.

The former condition is uncommon, cases having been described by Maseritz[35] and Cooper.[39] The bursa is mechanically irritating, and since it lies near the insertion of the affected interossei, it may disturb lateral balance of the finger, although no note is made of it in the published cases nor in the one case seen by me. The obvious

kinetic disability is limitation of extension of the affected finger and lateral balance of the finger is not tested.

In the typical scalenus anticus syndrome, diagnosis is based on association of neurologic and vascular lesions. There must be many cases in which the disturbances are minimal, so that there is difficulty with precisional diagnosis—cases of obscure scalenism in which there are relatively minor weakness of the interosseous muscles of the fourth and fifth fingers.

Two such cases are here reported. The second case seen is presented first, for it threw light on the first case.

CASE XII. Mildred G., a colored girl of nineteen, complained of a weak and tired feeling in the fourth and fifth fingers of the right hand for a year. The hand was not painful and occasionally she had a "pins and needles" feeling in the fingers. She had noted that the knuckles of the affected fingers were placed on a lower level than those of the index and middle fingers when she clenched her hand. The dorso-ulnar half of the hand was flattened and the fourth dorsal interosseous space was sunken in distally. She could not abduct the ring finger well, indicating weakness of the fourth dorsal interosseous muscle. The second and third volar interossei and the abductor digiti quinti brevis were strong. The relatively greater strength of the second volar interosseous muscle was shown by the radial displacement of the fourth metacarpal head, so that it approximated the third metacarpal head, thereby increasing the distance between the fourth and fifth metacarpal heads. There was hypotonic relaxation of the carpometacarpal joints of the fourth and fifth fingers. No sensory changes were present in the ulnar nerve distribution.

The little finger presented a mild familial clawing deformity with valgus deviation of the second phalanx on the first.

It was suggested by the house surgeon, Dr. Caroll Silver, that the probable cause for this slight imbalance of the interossei was not a local thing but due to an occult or obscure scalenism. The neurological consultant believed the condition due to pressure on the roots of the eighth cervical and first dorsal by the cervical rib found bilaterally in roentgenograms of the neck. The hands showed foreshortening of the fourth and fifth metacarpals on each side. Blood pressure readings on each side were 94/60.

A myotomy of the right scalenus anticus muscle was done on May 23, 1940. The postoperative course was not eventful. There was immediate improvement, which has been maintained (January 17, 1941). There is no muscle atrophy, only slight dropping of the fourth and fifth metacarpal heads, and the grip of the hand is good. She has no complaints.

Microscopic examination of the muscle showed striated muscle fibers, some of which were fragmented and hyalinized.

This patient illustrates the point that sometimes mild and obscure intrinsic muscle imbalances may be due to scalenism.

The following case, antecedent in time to the above case, seems in retrospect also to be due to obscure scalenism, although the neck was not examined.

CASE XIII. Mary F., fourteen years old, noted some difficulty in the individual use of her right fourth finger in typing, the finger catching under the third finger. At the age of one, she had diphtheria, followed by a right hemiplegia which was said to have resolved completely.

She could not abduct the ring or fourth finger intrinsically. The fourth dorsal interosseous muscle was weak, the second volar interosseous muscle strong. The third volar interosseous muscle was not as strong as the second. In extrinsic extension, the ring finger did not abduct as much as the others, and was radially deviated. This was not due to common extensor action for such action was strong, though the line of pull of the common extensor tendon was more oblique than normal. When the finger was placed in the intrinsic position ulnarly, release of the finger snapped it back radially. This is a lateral interosseous rebound. There seemed to be slight atrophy of both the dorsal and volar interosseous muscles. The circumference of the right hand was 6¾ inches, that of the left hand 7 inches. The patient was left handed.

The neurologist noted nystagmoid jerks of the eyes in the lateral plane, hyperactivity of all deep reflexes, easily exhausted and poorly elicited abdominal reflexes. A right Hoffmann and Babinski sign were noted. A residual hemiparesis with perhaps some involvement of the ulnar nerve after diphtheria was suggested.

Another neurologist believed the hand disability was not of neurogenic origin.

The disabling weakness of the fourth dorsal interosseous muscle was corrected by an extensor plasty. I had thought this operation original but it has been used by Bunnell[40] and by a German surgeon, the reference for whose work I cannot now find. The extensor plasty seems to be the simplest substitute for an isolated paralysis of an interosseous muscle. This method is most suitable when either the proper or common extensor tendon of index or little finger can be used. This makes the substitution by tendon transfer of the paralyzed second volar or third dorsal interosseous muscles difficult, unless the adjacent common extensor tendon be split in two. This seems inadvisable for it is expected that the common extensor tendon serve two actions, not always synergistic —common extension and intrinsic abduction or adduction. Extensor translocation instead of transplantation may be tried in a finger with two extrinsic extensor tendons.

The tendon chosen is sectioned transversely at the level of the metacarpophalangeal joint or a little distal to it, and sutured to the extensor aponeurosis of the base of the proximal phalanx near the normal insertion of the paralyzed interosseous muscle. The finger is then splinted in the intrinsic position in lateral deviation corresponding to the normal interosseous muscle.

This operation was done on January 14, 1939. An incision between ring and little finger exposed the extensor tendons of the fourth and fifth fingers. The incision was longitudinally placed, began at the level of the proximal interphalangeal joint of the little finger, and extended proximally 1½ to 2 inches. The conjoined tendon was cut and the common extensor of the little finger freed. It was cut transversely about ¼ inch distal to the metacarpophalangeal joint and sutured to the extensor aponeurosis of the ring finger at or near the normal insertion of the fourth dorsal interosseous muscle, the ring finger being held in intrinsic ulnar deviation.

The postoperative course was uneventful. An immobilizing plaster bandage was removed two and one-half weeks after operation. She received physiotherapy, including sinusoidal stimulation and active exercises. The result is an excellent one and the patient was quite satisfied when she was seen last on March 23,

1940. The use of the operated finger was good and the ring finger no longer caught beneath the middle finger. The ring finger had fairly good strength both in intrinsic ulnar abduction and in common extension, the wrist tending to flex palmarly as she executed these movements.

This case is a complicated one. Whether the paralysis of the affected muscle is postdiphtheritic, cortical, or by obscure scalenism is difficult to say. At any rate, a simple procedure gave clinical satisfaction.

Isolated contracture of a finger by interosseous action is not common but is most likely as the intrinsic abduction contracture of the little finger after trauma.

Crossed Fingers. The spastic hand may sometimes show crossing of the fingers, usually the fourth over the indrawn fifth finger. This finger may be in the intrinsic position, its overlapping finger in the extrinsic position, or both fingers may be in varying degree of the extrinsic flexion position or contracture. An instance of the latter was seen postoperatively in the hand of a woman unsuccessfully operated upon for the relief of Dupuytren's contracture. Pack[41] reported an instance of flexion and crossed finger deformity present since birth in a patient with congenital neurofibromatosis of hand and forearm. The index finger was crossed over the middle finger. He stated that this was a common neurogenic deformity.

INTEROSSEOUS MUSCLE STRAIN

Following a trauma, either direct or indirect, a strain of an interosseous muscle, usually a dorsal interosseous muscle, may develop. Usually, it is the first dorsal interosseous muscle which is strained. I have seen instances of second dorsal interosseous and third volar interosseous muscle strain. The strain of the first dorsal interosseous muscle may be a part of a more diffuse occupational hand strain. The belly of the affected muscle may be tender and there is usually a small, sharply localized, very painful spot at the site of insertion of the muscle. Pain is

increased when the muscle is stretched and this pain may radiate up the hand to the forearm or along the extensor aponeurosis. Resistance to the normal movement of the muscle is also painful.

Physiotherapy is helpful but sometimes it is necessary to inject this painful area with novocain (2 cc. of a 1 per cent solution) and alcohol (0.1 cc. of a 70 per cent solution) several times.

DISABILITIES OF THE LUMBRICAL MUSCLES

It is always difficult to differentiate pure lumbrical disability from pure interosseous disability, because both have similar action in intrinsic extension and because disability of one is usually associated with disability of the other. The finger with pure lumbrical disability shows weakness of intrinsic extension but no lateral deviation. This is not enough to localize disability anatomically.

The lumbrical muscles cannot ordinarily be palpated, with the occasional exception of the first. This may be felt when, the finger being flexed fully at its metacarpophalangeal joint and extended at its interphalangeal joints, the index finger bends in maintained metacarpophalangeal joint flexion. This test is informative in rare instances. All other tests of intrinsic extensor function test both lumbrical and interosseous power, by placing the fingers actively in the intrinsic position, by flicking the fingers, by finger squeeze, and by testing extensor rebound. The intrinsic lateral movement of the finger tests interosseous power, either singly, in an *en masse* to and fro ulnar and radial swing of the fingers to test them all in intrinsic abduction or adduction of the fingers, or in flexion of the metacarpophalangeal and proximal interphalangeal joints to rule out common extensor abduction.

The action of the two sets of muscles is co-ordinated in intrinsic movement. *Disability of one must be reflected in disability of the other.*

In the repair of interosseous and lumbrical disability, it will be more necessary to regain extensory power than lateral power. Most operative procedures try to do that.

CASE XIV.   *Hypertrophy of the First Lumbrical Muscle with First Dorsal Interosseous and Adductor Muscle Strain.*   In July, 1935, I saw a young woman of twenty-two, with a swelling of the palm of her right hand in the line of the tendons of the index finger. Exploratory operation under local anesthesia showed that the mass of the first lumbrical muscle was unusually large. The muscle was not resected.

In December, 1934, while wheeling a cart into the operating room, she struck the dorsum of her right hand against the wooden casing of a door, the hand being forcibly jammed between the casing and the cart. The palm of the hand was struck obliquely. The hand was ecchymotic and the dorsum of hand abraded. A week later, a swelling was seen in the palm of the hand, which became more noticeable when the index finger was moved. This swelling gradually became larger. Pain was inconstant and dull at first, but became sharper, when the thumb and index finger gripped something. In January, 1935, she did a great deal of writing during her examinations as a student nurse. Dull ache now became quite constant. It was localized both to the palm and dorsum of the hand, and pain radiated up the extensor side of the forearm, not only from the area of palmar swelling, but also from the region of the first dorsal interosseous space. It was made worse by certain motions of the hand in writing, sewing, typing, and on certain gripping movements. Rainy weather, the period just before change of weather, and the few days preceding her menstrual period, increased the intensity of pain. The hand often felt fatigued. Sometimes, the fingers felt stiff, and on some mornings, they were kept in slight flexion at the interphalangeal joints and in slight extension at the metacarpophalangeal joints. The wrist, too, felt weak. Pressure over the wrist produced sharp pain, radiating up the arm, and even to the shoulder.

The left hand also became painful, duplicating to a lesser degree the symptomalogy of the right hand. This followed the splinting of the right hand after operation and seemed due to the necessarily increased use of the left hand during that time. A similar, but smaller swelling, was noted in the left palm.

The right palm showed a soft, elliptical, and nonfluctuant swelling, one inch long and three-eighths inch wide, placed radially to the line of the tendons of the index finger and just within the thenar crease. It did not contain fluid and its aspiration gave none. The mass followed the line of the first lumbrical muscle.

She felt strain of her hand when the index finger was put into the intrinsic position, and the swelling became larger. When the finger was put into intrinsic radial abduction there was a greater feeling of strain. Motion of the index finger was free and noncrepitant. The mass did not increase in size on common flexion and extension of the finger. When the index finger was flexed at its three joints, attempted extension of the finger in maintained metacarpophalangeal joint flexion, gave her dull pain in the line of the flexor tendons of the index finger. She had no pain when the metacarpophalangeal joint was extended as the finger was extended.

A tender point was present in the distal palmar crease of the fourth and fifth fingers. The insertion of the adductors transversus and obliquus was tender both dorsally and palmarly on deep palpation. The first dorsal interosseous muscle was diffusely tender, especially near its origin from the base of the second metacarpal bone. The mid-part of the web of the thumb was tender.

The right hand measured 8½ inches in the area of swelling, the left 8 inches.

The right wrist was tender and crepitant over the region of the insertion of the extensors carpi radialis longior and brevior.

The palm of the left hand was similarly swollen, but the hand was only slightly painful and tender. The flexor tendons of the index finger creaked a little on motion of that finger.

Roentgenograms of the right hand were negative.

The postoperative therapy which proved effective for relief of pain was the repeated injection of 2 cc. of 1 per cent novocain and 0.2 cc. of 70 per cent alcohol dorsally into the area of adductor insertion, injections being given once weekly over a two-month period from March to June, 1936. Overuse of the hand brought about some recurrence of pain. The swelling in the palm remained unchanged.

The patient has a previously unnoted, bilateral, probably congenital hypertrophy of the first lumbrical muscle. The normal first lumbrical muscle is larger than the other three, but it is usually never more than a slender mass of muscle. It is doubtful if the injury created hypertrophy of this lumbrical muscle, but it did cause strain of this muscle, which was aggravated by the excessive use of the thumb and index finger in writing and sewing.

The first dorsal interosseous muscle and adductors of the thumb also received part of the primary trauma. Injury of the first lumbrical muscle may create a strain of the first dorsal interosseous muscle, since both muscles flex the metacarpophalangeal joint of the index finger and extend its proximal and distal interphalangeal joints. Strain of the first dorsal interosseous muscle is also reflected in adductor muscle strain, since both are adductors of the thumb. The primary effect of injury may have been upon the first dorsal interosseous muscle with secondary strain of the first lumbrical muscle. It is, however, more likely that both the adductor mechanism of the thumb and the first lumbrical were hurt at the same time.

CONGENITAL ANOMALIES OF THE LUMBRICAL MUSCLES

A study of congenital anomalies of the lumbrical muscles was made because the case of congenital hypertrophy of the first lumbrical muscle indicated that such anomaly might be clinically significant. Anatomical variation in the number and form of these muscles is sometimes seen.

Example. The dissection of the left hand of a middle-aged negro cadaver showed a supernumerary first lumbrical muscle with antibrachial origin, an anomaly absent in the right hand. It was placed radially to the normal first lumbrical muscle, beginning in the forearm by a thin fleshy belly which merged with the fleshy part of the flexor sublimis digitorum of the index finger. The muscle belly ended in a thin tendon, placed radially to the flexor sublimis tendon of the index finger about 4 inches above the wrist joint. The tendon in turn ended in a slender muscle fasiculus 2 inches long and ¼ inch wide just above the wrist joint. The fasiculus, passing through the tendinous compartment of the wrist, glided freely in its channel without adhesion to adjoining tendons. It ended in the palm in a thin, silvery,

tendinous thread about 2½ inches long, which inserted on the extensor aponeurosis of the first phalanx of the index finger proximal to the insertion point of the normal first lumbrical muscle and anterior to the termination of the tendon of the first dorsal interosseous muscle.

Review shows few references to anomalies of the lumbrical muscles but some of the textbooks note that variations in number of the lumbrical muscles are not uncommon. Macalister pointed out that the lumbrical muscles varied frequently in their origin by the addition of occasional heads of origin from neighboring tendons. The third lumbrical muscle is more often the site of such variation and he saw two irregularities of that muscle for every instance of variation in the other muscles. A series of six cases of anomalies of the first lumbrical muscle observed over a period of thirty years was reported by Gruber. In three of these cases, double first lumbrical muscles were seen, the extra one arising from the volar carpal ligament. Re-enforcement of the normal first lumbrical muscle by a belly or tendon from the flexor longus pollicis or from the superficial flexor tendon or replacement of the first lumbrical muscle by bellies from these origins has been reported.

The antibrachial origin of a supernumerary first lumbrical muscle has been described by Wood (1868), Macalister (1872), Bellini (1892), and Ledouble. The antibrachial origin of the second and third lumbrical muscles was reported by Dambrin (1930).[42–49]

PARALYSIS OF THE INTRINSIC MUSCLES—THE CLAW HAND

The fingers are hyperextended at the metacarpophalangeal joints and flexed at the interphalangeal joints when clawed. The wrist is usually palmarly flexed. The cause of deformity is *paralysis* or *weakness* of the balancing lumbricals and interossei. The deformity is more usually seen in the paralytic hand of poliomyeletis, ulnar nerve palsy, and other neurological lesions.

It is a transient or dissociated lesion in spastic paralysis, especially, in the athetoid hand. It is also seen in the arthritic hand and in the hand clawed by ischemic contracture. Clawing is favored by palmar flexion of the wrist, and the kinetics of this mechanism has been analyzed by Steindler. When the wrist is fixed in palmar flexion, the claw hand may follow by stretching (passive insufficiency) of the common extensor tendons. The metacarpophalangeal joints are placed at a central point in the lever whose power is derived from the extensor muscles. It therefore hyperextends more easily than the other phalangeal joints.

It is not ordinarily possible to extend the distal two phalanges of a finger fully, when the first phalanx is maintained in complete hyperextension. The effort to do so causes strain of the stretched flexor sublimis tendon. The maximally stretched flexor sublimis tendon resists the effort at full extension. The distal two phalanges can only extend when the metacarpophalangeal joint is not hyperextended and the movement is more easily carried out in extension or slight flexion of this joint. The paralysis of the intrinsic muscles may then only be apparent and not real when the finger is clawed, unless intrinsic extension is tested in extension or slight flexion of the metacarpophalangeal joint.

The operative procedures may attempt rebalancing by reconstruction of a lumbrical, using a whole or part of a flexor tendon, or it may place the proximal phalanx in advantageous flexion by stripping of the collateral ligaments or by a sling operation.

The claw hand which is not yet fixed in contracture may be corrected by an attempted rebalancing operation, especially in ulnar nerve palsy. In infantile paralysis, the flexor muscles may also be paralyzed and hence not available for transplantation.

Each case is an individual problem. It is of course not always necessary to restore intrinsic extension and the hand may be useful, given good finger flexion. In one operation (Stiles operation according to

Lyle) the flexor sublimis tendon of the affected finger is freed, split longitudinally and each half transferred dorsally to the corresponding side of the extensor aponeurosis of the first phalanx. The Stiles operation according to Baldwin[14] is the dorsal transfer of the radially split third of the flexor profundus tendon. Bunnell's[8,40] modification of the Stiles operation passes the split sublimis tendon through the lumbrical canal with suture of the tendon to the dorsal surface of the transverse fibers and lateral band of the extensor aponeurosis.

It may be worth while to transfer the radial half of the flexor sublimis tendon to the dorsal aponeurosis. Silfverskiöld[12] transplanted the distal tendons of the flexor sublimis muscle dorsally to the extensor aponeurosis just distal to the metacarpophalangeal joint with good result in a case of ulnar nerve palsy.

Potter's operation[50] stabilizes the metacarpophalangeal joint by opposing the action of the long extensor and flexor sublimis digitorum. He noted that when the first phalanx was held, the finger could not claw. The paralyzed deep flexor tendon is sectioned transversely proximal to the proximal interphalangeal joint, split lengthwise, passed dorsally beneath the superficial flexor tendon, and sutured to itself. A sling was made preventing the hyperextension of the metacarpophalangeal joint. The distal half of the deep flexor tendon is split to increase tendon length. Each strip is passed dorsally over the middle phalanx, sutured to its fellow, and the proximal end is joined to the common extensor tendon to give active extension of the distal two phalanges. No cases were reported but the author claimed satisfactory results in a limited number of cases done soon after the end of the first World War.

When extension contracture of the metacarpophalangeal joint is present, it may be released by the distal stripping of the collateral ligaments of this joint, an operation described by Shaw[51] in 1920. The long sustained and unopposed extension or hyperextension position of the metacarpophalangeal joints finally leads to contracture, with resultant limitation of flexion, both actively and passively.

The operation serves a triple purpose, but only if the finger flexors show power. It gives a better looking hand, it relieves the hyperextension contracture, and it allows a certain amount of active flexion in the operated metacarpophalangeal joint through indirect and long arm leverage of the finger flexors. The hand may be closed to greater or lesser degree. The Shaw operation does not in any way substitute for the paralyzed interossei and lumbricals. The wrist must be in dorsiflexion before the operation is done. The drop wrist must first be arthrodesed to avoid recurrence of finger deformity, for the palmarly flexed wrist conditions the claw hand.

Dr. Harry Sonnenschein and I used this operation for the relief of the hyperextension contracture of the metacarpophalangeal joints in two cases of the (infantile) paralytic claw hand, two cases of nerve palsy, and one arthritic hand. The operation has not been previously used in the surgery of the paralytic hand. It has been used in traumatic fibrous ankylosis of the metacarpophalangeal joints, Koch[52] reporting his results with this operation. Manipulation of the metacarpophalangeal joints is not satisfactory and the joint may subluxate before the collateral ligaments give. Shaw, however, believed these ligaments could be freed by manipulation.

Each ligament is a lateral re-enforcing band in the thin capsule of the joint. The course of each collateral ligament is oblique, from dorsal and proximal to palmar and distal. Its point of attachment on the metacarpal bone is marked by a little bony prominence. They are relaxed in extension to allow lateral mobility of the joint; in flexion, however, they become taut so that lateral mobility is lessened. The collateral ligament can be sectioned and stripped without opening the joint capsule.

The operation is then indicated in the contracted claw hand, if the wrist can be maintained in dorsiflexion, and if there is active flexion power of the fingers.

OPERATIVE TECHNIC

Five dorsal longitudinal incisions are used, each about 1 inch long. Each begins about ½ inch proximal to the knuckle and extends distally to the lateral aspect of the base of the proximal phalanx. The incisions between webs serve for adjacent fingers. It is necessary to section the conjoined extensor tendons and the proximal part of the extensor aponeurosis of the finger. After retraction of the extensor tendon on one side and the atrophic belly of the interosseous muscle on the other, the metacarpophalangeal joint and its collateral ligaments are exposed. The collateral ligaments are variously developed. The individual ligament in contracture is a thick, narrow, oblique band. It is sectioned transversely at its metacarpal attachment just behind the metacarpal head and stripped distally. Much of the deformity is overcome after section of one collateral ligament, but both must be cut for full correction. If only one side is stripped, there may be snapping back of the finger into lesser extension at the metacarpophalangeal joint or lateral deviation of finger to the side of the uncut ligament. The hand is splinted in flexion by plaster or by banjo splint traction. Physiotherapy limbers the fingers and increases the grasp of the hand.

Shaw's technic seems simpler. An incision, 1.8 to 2.5 cm. long, was made on the side of the extensor tendon, and the metacarpal bone near the metacarpophalangeal joint exposed. The periosteum was raised forward and distally till the proximal attachment of the ligament was seen. It was divided and stripped with the periosteum.

The operation was once modified in that the dorsal capsule with its collateral ligaments was stripped distally from its metacarpal insertion.

Kofman[53] recommended osteotomy of the metacarpal for the correction of the "main en griffe."

CASE XV.   Nicholas Z., a boy of seven, had a flail left upper extremity as a sequel of infantile paralysis. The wrist was flexed to 100° and deviated ulnarly 70°. He was able to extend the wrist by action of the extensor carpi ulnaris. He had a typical paralytic claw hand. There was a fair degree of power in the flexors of the fingers.

Stripping of the collateral ligaments of the metacarpophalangeal joint was done on January 15, 1936. Arthrodesis of the shoulder was done on February 5, 1936. A transplantation of the tendon of the extensor carpi ulnaris to the paralyzed tendons of the extensors carpi radialis longior et brevior was done on March 31, 1937. He was last examined on September 26, 1941. The arthrodesis of the shoulder was solid. He was able to dorsiflex the wrist against some resistance in ulnar deviation by action of the transplant. The hand was useful for grasping and he was quite satisfied with the result of the Shaw operation. The hand was not clawed and active flexion of the metacarpophalangeal joints was to 150°. The most interesting thing was a return of extension power to the distal two phalanges of the fingers. He was able to extend these phalanges when the fingers were flexed and he could extend the fingers at all three joints. A Bunnell operation failed to give opposition of the thumb and its revision was advised.

CASE XVI.   Emily R., a colored girl of eleven, has a flail paralytic left upper extremity. On September 28, 1932, arthrodesis of the left shoulder was done, which was revised on November 15, 1933. A flexor plasty of the elbow was done on April 5, 1933. The wrist was fused on June 27, 1934. A transplant of the flexor carpi ulnaris to the common extensors was done at the same time. The wrist was fused at 180°, but increasing radial deviation developed because a bone graft, used in the fusion, interrupted the growth of the lower radial epiphysis radially. These epiphyses were later ablated.

The paralysis of the intrinsic muscles of the hand with extension stiffness of the metacarpophalangeal joints indicated the stripping of the collateral ligaments. Finger flexor power was good. She had a flat hand. The release of the

collateral ligaments was done on June 19, 1935 by Dr. Harry Sonnenschein through three incisions, instead of five. These were made along the lateral aspects of the metacarpophalangeal joints of the index, middle, and ring finger.

She was last seen on July 25, 1941. The wrist was solidly fused in some radial deviation. The forearm was pronated. The thumb could not be opposed and its carpometacarpal joint was contracted dorsally. She could bring the thumb to the middle finger by pseudo-adduction movement.

The result of the Shaw operation is satisfactory to the patient. She is able to hold things much better than before operation. In the resting position, the fingers are held at 175° of flexion at the metacarpophalangeal joints but active flexion is only possible to 165°. Active extension was possible to 235°.

The follow-up in these two patients is five and one-half years and six years, and in both the result is good.

The two patients with nerve lesions are both adults and the follow-up is not as long.

Case xvii. The first patient, a woman of thirty-seven, had a bullet injury of the medial side of her left arm in 1929, resulting in median and ulnar nerve injury. A postoperative sensory defect (after laminectomy for causalgia) exists in the distribution of the eighth cervical and first dorsal roots.

She had a flat hand with fixed clawing of the fingers. The wrist had good power of dorsiflexion. On September 7, 1939, the collateral ligaments of the index and middle fingers were released. The ring and little fingers were manipulated into flexion. The deformity recurred and the point was raised whether recurrence was unavoidable because of the lack of balance of the hand. This is the defect of the operation, that it does not restore intrinsic power. It was believed, however, that, if the operation had proved itself of value in the poliomyelitic hand, it would be of value again, the development of fibrous ankylosis in some flexion mitigating against recurrence of extension contracture. On March 13, 1941, the operation was revised, the collateral ligaments of all the fingers, except the ulnar one of the little finger being sectioned and stripped distally. The dorsal capsule of each joint was opened in each finger during the stripping.

The fingers are now in slight flexion and are more advantageously placed for grasping. She expresses herself as fairly well satisfied. It is interesting that the little finger shows an abduction position of almost 35°, due to the fact that its ulnar collateral ligament was not stripped.

A Bunnell operation was done on April 18, 1940, together with release of the dorsally contracted capsule of the carpometacarpal joint of the thumb. After the revision of the Shaw operation, the ability to move the thumb across the palm receded and is being slowly regained. It is, therefore, advisable that reconstructive work on the thumb be postponed till after finger correction.

Case xviii. The second patient, a man of thirty-three, had a palsy of the ulnar nerve and of the posterior interosseous after a bullet wound of the left forearm in 1938. On January 11, 1939, suture of the ulnar nerve was done with some return of sensation. The posterior interosseous nerve was cut below the level of the supinator brevis and its repair was inadvisable. Wrist extension was weak and an extension contracture of the metacarpophalangeal joints existed by passive stretching of the paralyzed common extensor tendons. A fusion of the left wrist was done on April 6, 1939.

The extension contracture of the middle, ring, and little fingers was released on March 14, 1940, and of the thumb and index finger on June 13, 1940.

An effort was made to limber the metacarpophalangeal joints before this operation but some fibrous stiffness persisted in flexion. On May 12, 1941, the extensor carpi radialis and ulnaris were transplanted into the common extensor tendons of the fingers, and the flexor carpi ulnaris into the extensor brevis pollicis. The extensor tendons of the little finger and ring finger were adherent to the metacarpophalangeal joint and displaced a little ulnarly. Pull of these tendons did not extend these fingers. (It would seem that the Shaw operation would tend to make an extensor transplant less effective.)

Two years after the Shaw operation, the fingers were held in flexion at the metacarpophalangeal joint. He could not extend them. He could grasp objects strongly and felt that the operation had helped him a good deal.

Fibrous stiffness of the metacarpophalangeal joints in arthritics limits flexion of the fingers

at these joints. The disability is an extension contracture which is corrected by the stripping of the collateral ligaments.

CASE XIX. Rosa B., a woman of forty-five, was first admitted on September 23, 1935, for manipulation of an arthritic right shoulder. The arthritic right hand was manipulated on September 9, 1936, with no improvement. The metacarpophalangeal joints of the right hand showed marked limitation of flexion. There was also limitation of flexion at the interphalangeal joint. The thumb could be opposed only to the index finger because of an adduction contracture of the thumb. Motions of the right wrist were possible from 180° to 160°. On September 16, 1936, the stripping of the collateral ligaments of the affected metacarpophalangeal joints was done. The postoperative course was uneventful.

This patient has been examined periodically in the clinic, the last note pertaining to her hand being made on September 11, 1937: The function of the hand is improved and it is possible to flex the fingers at the metacarpophalangeal joints more than before, although she cannot make a full fist, because of arthritis of the distal interphalangeal joints. The result of this operation can be considered good.

ROTATION OF A FINGER

There is no kinesiological mechanism permitting rotation of a finger. The normal finger can be passively rotated a few degrees but active rotation is not possible. The movement is a rotary one of the whole finger on its relatively fixed metacarpal.

Shaw noted rotation of a finger after division of one collateral ligament of its metacarpophalangeal joint. Radial rotation of the left middle finger of a negro adult followed an oblique fracture of the base of its proximal phalanx, the fracture line running from proximal and ulnar to distal and radial.

COMBINED LACERATION OF THE TENDONS OF INSERTION OF THE LUMBRICAL AND INTEROSSEOUS MUSCLES

Laceration of the tendon of insertion of a lumbrical muscle seems uncommon, but is quite likely that it is missed in the usual examination of the hand which does not concern itself with the intrinsic muscles of the hand. It must be thought of in associated lateral imbalance, when the tendon of insertion of an interosseous muscle is cut. Usually, both tendons of insertion are cut, either by a direct lacerating trauma or by an improperly placed operative incision. The radial digital nerve may also be cut at the same time. An accurate anatomic diagnosis can be made so that the operative findings may be foretold for proper operative procedure, which is suture in the intrinsic functional position.

Usually, the first lumbrical and first dorsal interosseous tendons of insertion are cut because of their more exposed position on the radial side of the index finger. The direction of incision or cut is more easily an oblique one, which runs from radially and distally to ulnarly and proximally at the base of a finger. Three such cases have been examined.

Other possible combinations, given a cut or incision running similarly at the base of the other fingers are: the second lumbrical and second dorsal interosseous muscles, the third lumbrical and second volar interosseous muscles, the fourth lumbrical and the third volar interosseous muscles.

If the cut or incision runs in opposite direction at the base of a finger, the lumbrical tendon may be missed since it inserts radially. The intrinsic muscles which may be singly cut are: the first volar interosseous muscle, the third dorsal interosseous muscle, the fourth dorsal interosseous muscle, and the hypothenar muscles.

DISABILITY IN FINGER FLEXION

Disability in finger flexion constitutes a most important chapter in hand disability. Its broadest aspects are only considered in this study and reference to medical literature will disclose a multitude of excellent papers on each individual condition and its treatment.

In general, flexion disability may be put into two categories of disability: The inability to open the hand is caused by flexor

contracture or extensor weakness, while the inability to close the hand is due to extensor contracture or flexor weakness.

Flexion contracture is extratendinous as in Dupuytren's contracture, tendinous as after old laceration or infection of the flexor tendons, or muscular, as in the flexor muscle shortening of ischemic contracture and spastic contracture. The paralytic claw hand may show flexion contracture of its interphalangeal joints. Flexion contracture of the arthritic hand is either myositic, articular, or tendinous. All cause greater or lesser disability in hand opening.

When the affected finger is flexed at its metacarpophalangeal joint, extension of the adjacent fingers becomes automatically restricted, and this extension inability diminishes progressively in the fingers furthest away from the bent finger. The reverse is also true, that extension of a finger at its metacarpophalangeal joint automatically restricts flexion of the adjacent fingers, this restriction being least in the fingers furthest away from the extended finger. This point is worthy noting in Dupuytren's contracture and in other contractures in which the finger is flexed at its metacarpophalangeal joint.

Not infrequently in spastic and in ischemic contracture, the fingers become flexed at their interphalangeal joints, when the wrist is dorsiflexed because the flexor muscle bellies are shortened. This flexion is released by palmar flexion of the wrist. Secondary hyperextension of the metacarpophalangeal joints may follow. The Jones method stretches the shortened muscles by gradually extending the wrist, the fingers being held straight. Localized ischemic contracture is seldom seen.

The inability to close the hand by flexor weakness may be due to inflammation of the flexor tendons, recent or old laceration of these tendons, their paralysis as in infantile paralysis and median nerve paralysis.

After laceration of a finger flexor tendon, the finger flexes by interosseous muscle action only at its metacarpophalangeal

joint. Extensor contracture as by scar contracture with adherence of the extensor tendons restricts finger closing.

FLEXOR SUBLIMIS—FLEXOR PROFUNDUS DISSOCIATION BY SUBCUTANEOUS RUPTURE OF THE FLEXOR PROFUNDUS TENDON

It is normal that when one flexor tendon of a finger is injured, the other is also injured. Dissociation of power in favor of the sublimis flexor is quite uncommon.

CASE XX.   The patient, a man of twenty-six, fell on the tip of the right ring finger on July 14, 1940. Since then, he had been unable to bend the distal phalanx of the finger.

The distal joint was held in 2° to 3° of flexion. The joint could be passively flexed fully but there was no active flexion. Extension was fairly strong and there was an extensor rebound. The proximal joint flexed to 80° actively and extended to 180°. The metacarpophalangeal joint flexed completely but hyperextension was only 10°. The finger could not be clawed as well as its neighbors. Tenderness was present over the anterior and proximal crease of the base of the finger. Intrinsic motions were good. In making a fist, the distal joint did not enter into the palm. The grip was weaker than it had been. A roentgenogram showed an old healed chip fracture of the anterior aspect of the base of the distal phalanx by tendinous pull.

The finger showed no flexor variant deformity. There was isolated dysfunction of the flexor profundus. This was proved operatively, the adherent tendon having been torn obliqually.

An interesting observation is the inability to claw the finger well. When the normal finger is clawed, the flexor sublimis tendon is stretched, and first the proximal joint and then the distal joint go into flexion. If, for any reason the flexor tendons cannot stretch, as by adhesion of one or both flexor tendons, it becomes difficult to hyperextend the strained metacarpophalangeal joint. It is hard to claw the normal finger when its distal joint is held extended.

NARROWED HAND

Two instances of narrowing of the hand were seen. It is a deformity of the hand

created by a gross disproportion of the radial half or border of the hand (second and third metacarpals) and ulnar border of the hand (fourth and fifth metacarpals). The radial half of the narrowed hand was relatively flattened in a man with dorsal dislocation of the bases of the fourth and fifth metacarpals. In a woman of thirty-nine, whose right wrist was fused for tuberculosis nine years before examination, there was flattening of the dorso-ulnar part of the hand with volar dropping of the knuckles of the fourth and fifth fingers. The index and middle fingers diverged widely from the other fingers. In both cases there was disturbance in finger function.

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STEREOSCOPIC PHOTOGRAPHY FOR SURGICAL MOTION PICTURES*

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STEREOSCOPY is the science of creating an illusion of depth or three dimensions in a picture by binocular means. The principles of stereoscopic photography, for both still and moving pictures, have been known for a long time but only recent developments permit their practical application with relative ease. For instance, it is now possible to present, to a large audience, a full size motion picture in natural colors and three dimensions. Such pictures have been used for advertising and educational purposes. We believe that we are the first to employ this medium for recording the technic of surgical procedures. The following discussion concerns the latter application.

ADVANTAGES

Before discussing the subject at length, it might be well to review what advantages, if any, one has the right to expect of stereoscopic motion pictures made in the operating room. Few will deny the benefits resulting from the illusion of a plastic picture; that is, a picture that stands out in relief and in which spacial positions are readily portrayed in each of the three directions. In education the plastic picture can illustrate more clearly than can a flat picture. In surgery the plastic image shows definite spacial relations between various tissues, organs, and other anatomical parts, and illustrates the movements of the surgeon's hands and instruments realistically and clearly.

It is not so well known that a stereoscopic picture can more accurately render surface texture. In a flat picture all the large and small highlights situated here and there on each shiny curved surface are fixed in position and appear to be in the same place for each eye. In a stereoscopic picture, however, these highlights are unbounded and are free to occupy positions different for the left eye than the right eye—a natural situation. The two dimensional blotches representing highlights seem to shift away, leaving the surface more clearly visible. In surgery, in which the subject matter may consist largely of moist curved surfaces, the advantage of stereoscopy is apparent.

An additional, though perhaps minor, advantage results from the reduction of the obstructing tendency of objects interposed between the cameras and the object. The surgeon has every right to place his hands in the field of view when he is performing an operation, but only those who have attempted photography of an operation while it is in progress appreciate the difficulty of securing a satisfactorily clear field for both camera and the doctor simultaneously. Since, in stereoscopic photography, the scene is being photographed at all times from two separate viewpoints, there is naturally a small but valuable reduction in the percentage of time that the field of view is obscured.

Small sized films when enlarged greatly, sometime show the grain structure of the emulsion. When the films are viewed stereoscopically, however, the grain pattern is not the same for the left and right eyes and visibility of the grain is greatly reduced. At the same time an apparent increase in definition is realized, which improvement

215

is noticeable even with Kodachrome film, although Kodachrome has no visible grain. Even with the best of care, motion picture films accumulate some dust, dirt, scratches and other blemishes during their lifetime. Since any particular blemish will appear before only one eye, it follows that in stereoscopic viewing the effect of blemishes is reduced and the film life is increased.

STEREOSCOPIC TECHNIC

The technic of stereophotography and the presentation of stereophotographs present two separate problems: The first requires the exposure of two photographs simultaneously, from viewpoints separated by a distance that would correspond in a rough way to the separation between the human eyes, i.e., the interpupillary distance. The second requires the viewing of these two pictures simultaneously in such a way that they are apparently closely superimposed, yet at the same time the left eye must see only the picture taken from the left hand position and the right eye only the picture taken from the right hand position.

There are many known ways of taking such pictures, but in general these may be divided into two classes, the single system and the double system. In the single system the two pictures are exposed on the same film. In the double system, separate films are used, sometimes in two separate cameras, sometimes in a special single camera with two lenses. The well known beam splitter suitably centered in front of nearly any camera will convert that camera into a single system stereocamera. But this simplest of all stereocameras has several disadvantages: the film area is reduced, the field of view is reduced for a given lens, the frame becomes an unfortunate shape, there is light loss at the image, centering is difficult, fast lens are more difficult to accommodate without blurring in the central regions, and certain distortions appear. Until commercial equipment to meet particular requirements becomes available, the double system is the most practical for

serious work in stereoscopic motion pictures. This is true because standard cameras and projectors of high quality can be linked together in pairs with a minimum of mechanical alteration, and the resulting equipment will be able to meet most requirements satisfactorily.

Two films of exactly the same length are exposed at once in the two cameras. Each film is exactly standard in all respects and each includes the same view of the operative field. Either length can be projected alone in any suitable standard projector and in case one should become damaged or destroyed, a complete record would still exist in the other. Moreover the two can be projected together with special equipment mentioned below in such a way that a full three dimensional or stereoscopic scene results.

It is possible, of course, for one person at a time to view the stereoscopic movies with special equipment much after the method of the old-fashioned stereoscope that a few generations ago was found in the parlor of any well appointed household. Far more satisfactory, however, is the projection of the motion pictures upon a full sized screen to be viewed simultaneously by a relatively large group of people. Such projection has recently become practical through the development by the Polaroid Corporation of methods of manufacturing large thin sheets of polarizing material. Such material placed with the proper orientation before two projectors and before each eye of each individual in an audience can satisfactorily meet the requirements mentioned above for selective viewing of the images for the left and right eye. Moreover, satisfactory polaroid viewing devices are available for as little as a few cents each.

EQUIPMENT FOR STEREOPHOTOGRAPHY

Having established our technic for stereoscopic motion pictures, we will discuss in more detail the making and the projecting of such pictures.

Any film width satisfactory for ordinary motion pictures is suitable for stereoscopic

motion pictures and the authors have experimented with 8 mm. and 16 mm. The standard 16 mm. width is to be preferred over 8 mm. or 35 mm. for surgical work because (1) it is readily available in Kodachrome as well as in black and white; (2) when exposed on good equipment, it has ample definition for most requirements; (3) sufficient light intensity can be obtained for satisfactory projection to audiences of several hundred people; (4) film cost is considerably less than that of 35 mm. film; (5) the depth of field, while not as great as on 8 mm. film is not a serious handicap even under unfavorable lighting conditions and is greater than that on 35 mm.; (6) all 16 mm. film is safety base; (7) when the twin projectors are not available, either of the two films may be shown individually on any standard projector; (8) the cost of the 16 mm. film is considerably less than for 35 mm. film.

The best results are not obtainable in any photographic work without excellent equipment maintained in excellent condition. Several manufacturers make suitable equipment for a stereoscopic adaptation and the Eastman magazine loading cameras shown in Figure 1 are but an example.

Two cameras are required. Services of a good mechanic must be obtained for the purpose of constructing suitable shafts for coupling so that the two cameras may be located side by side and operated at exactly the same speed. Synchronism can be achieved electrically or mechanically. If mechanical, the coupling must be flexible enough to permit variation of the angle between the cameras. Synchronism must be accurate to a small fraction of one frame. Backlash of coupling should not be more than 5 or 10 degrees, measured on a single frame shaft. It is easy to maintain this small backlash angle with mechanical coupling but electrical synchronization offers the advantage of versatility in camera positioning. The authors used the mechanical form of coupling.

In some cases it is desirable that the distance between cameras be adjustable;

for long shots the cameras should be moved farther apart, and for closeups, closer together. Alternately, closeups can be secured with longer focal length lenses from a distance, without adjusting the cameras so close together. The photography of surgery should be in closeups when possible and a small camera interspace is generally indicated, since the thickness of the individual cameras limits the available proximity. It is believed that adjustment of the distance between cameras is unnecessary in surgery, and recourse to telephoto lenses is imperative.

A mounting jig must be made to meet the following requirements: It should permit rapid and easy mounting and removal of the cameras. When mounted the cameras should be accurately and consistently aligned, and the correct spacing for the synchronizing shaft should be maintained. If one camera obstructs the loading function of the other, provision should be made for swinging the one out of the way. Finally, there should be an adjustment to permit the cameras to be toed in so that the optical centers can be caused to converge at various distances into the field of view. There should be a scale attached in such fashion that the distance can be set as required, according to the technic recommended below.

Figure 1 shows the magazine Cine Kodaks mounted in the jig and synchronized ready to take pictures. In Figure 2 is shown the mounting jig which is one of many possible designs. The right camera is attached at (A) by means of a screw into its tripod bushing, and the left camera at (B). (C) is a pivot to permit the left camera to be lifted out of the way when the right camera is being loaded with a magazine. When the left camera is swung back in place, its alignment is automatically re-established. The coupling shaft separates when this function is being performed. At (D) is a scale for the purpose of adjusting the angle between the cameras, much as a camera lens is focussed. This adjustment is permitted by the pivot (E). The center of the flexible coupling is
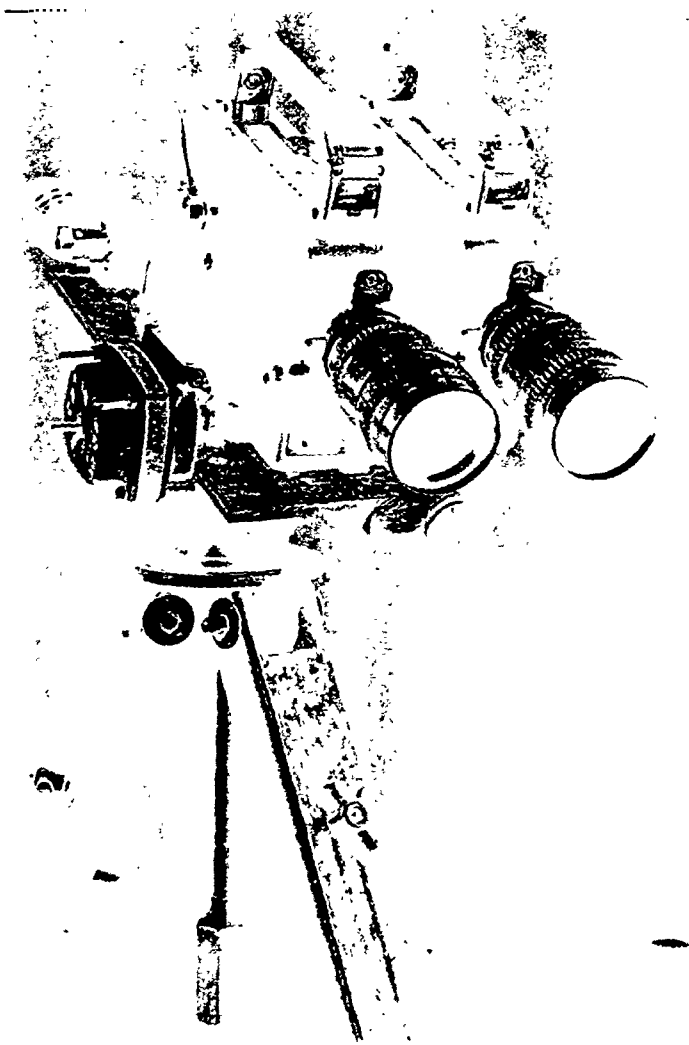
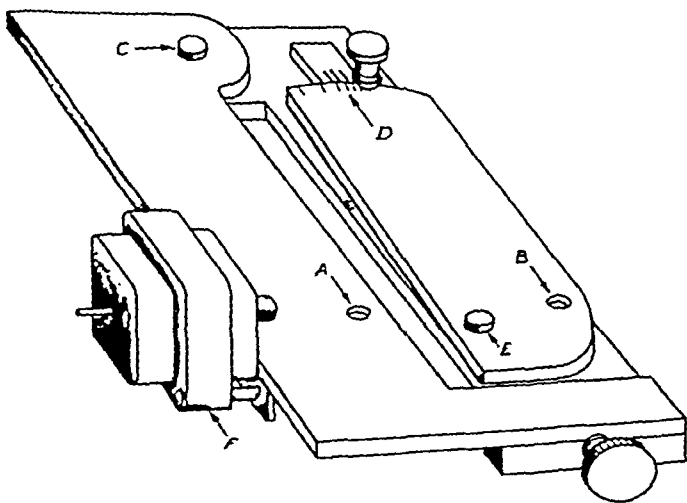FIG. 1. Two magazine cine kodaks mounted and synchronized.

FIG. 2. Mounting jig for stereoscopic cameras.

located on the axis of (E) to prevent stretching of the shaft when the angle is being adjusted. (F) is a non-sparking motor used to drive both cameras.

The photographic principles regarding composition, lighting, angles, etc., apply to stereoscopic photography much as they do to flat photography. It can be claimed, however, that lighting is of somewhat less importance in stereoscopic photography. A photographer taking a flat picture will, if he can, skillfully adjust his lights to accentuate the illusion of depth. Such a procedure is not so necessary when the image as later viewed will automatically reveal its own depth. Color film has less latitude than black and white film and the lighting problem for accentuating depth in a flat picture taken in color is more difficult because of this low latitude. In general, Kodachrome must be exposed with relatively flat uncontrasting light. If the illusion of depth suffers because of flat lighting in ordinary colored pictures, one might expect to find stereoscopy even more beneficial to color film than to black and white. The illusion of depth whether secured by lighting as in a flat picture or by stereoscopic means, is naturally of artistic value and has in addition instructional merit, since in a mechanical sense, it tells a story more accurate and complete in detail.

The boundary of a stereoscopic image is controlled by the position of the boundaries of the left and right images and it may lie in a plane either nearer or farther than objects in the scene. Since the boundary is like a window through which the observer is viewing, it would be very unnatural for it to be beyond the scene. This is one of the reasons for the toe-in adjustment mentioned above. The optical axes of the cameras should be adjusted to converge in front of the main objects in the scene. This will cause the framing window to appear to be interposed between the viewer and the scene, not beyond the scene.

In order to avoid the necessity of continually adjusting the amount of overlap when the pictures are being viewed, it is desirable to adjust the cameras so that their optical axes converge a constant angular amount nearer than the principal object in the scene. This is accomplished by a fixed displacement of the pointer against which the scale is read. The magnitude of this displacement is not critical but it is best to keep it uniform for a given sequence. A satisfactory angular displacement may be around 5 degrees for the normal or one inch lenses. For greater or lesser focal length lenses, the angular displacement should be fractionated inversely as the focal length. Thus for two inch lenses the angle should be reduced by one-half, and for one-half inch lenses the angle should be doubled. Since manufacturing tolerance in the framing member of projectors may apparently disturb the relations mentioned above, it is sometimes desirable to find the best angles by experiment. The simplest method of calibrating the scale for lenses of several focal lengths is to use but one angular scale, calibrated in feet, and to read the scale on a separate index or pointer for each of the lenses to be used.

A few comments on motion picture photography in the operating room may be in order. The use of color film is to be recommended but lighting and exposure difficulties are greater than with black and white film. It is necessary to expose with light, the color temperature of which is suitable for the particular color film in use, as outdoor Kodachrome or Type A indoor Kodachrome. Since the indoor film is faster it is to be preferred over outdoor color film for nearly any work using artificial light. Indoor color film is color balanced for lamps operating at a color temperature of about 3400 K. This is approximately the color temperature of photo-flood lights when operated at their rated voltage. The usual operating room lights burn at a cooler temperature and with Type A film will produce results with an excessively red color balance unless suitable filters are placed either in front of the camera lenses or over the lights. Whenever practical,

photo-flood lights should be employed, Type A Kodachrome film with no filters.

The determination of exposure with Kodachrome is especially difficult in the operating room. The use of an ordinary meter is not practical, since the wound is usually small, recessed, and darker than the surrounding drapes. To bring the meter close enough to measure only the light reflected from the wound would be to endanger the patient. Special meters are available which will rate the intensity of a small field at some distance. Possibly a more practical exposure adjustment can be obtained by calibration of numbers of photo-floods against distance to the wound at some specified line voltage. A handy disc type of exposure calculator can easily be made for quick computation. The optical range finder common in photographic circles is probably the best method of establishing the distance from the lights to the wound. For results of the highest reliability, it is usually necessary to measure the line voltage supplying the photo-floods. Measurement should be made with the photo-floods turned on since as little as 5 per cent variation in line voltage can produce a noticeable change in exposure and color balance. Once the exposure has been established only minor changes need be made to allow for light or dark tissues, shallow or deep cavities as experience dictates. R 2 photo-floods have a great advantage over ordinary photo-floods because of sturdy glass construction, compactness and general serviceability. When photo-floods are used for long periods, allowance should be made for the slow decrease in effective light power caused by slight blackening of the inside of the glass. R 2 photo-floods may be as much as one lens stop weaker at the end of their rated life of six hours.

It should be mentioned that the amount of depth appearing in a stereoscopic picture is a function not only of the camera interspace, but of other parameters, such as the focal length of camera and projector lenses, the camera distance, projector distance, and viewing distance. In addition, psychological considerations are of importance. On the other hand there is considerable tolerance in viewing, so that the depth can be accentuated or reduced and the picture will still look reasonably natural. Evidence of this is the fact that a flat picture may look natural although it has no degree of stereoscopic depth at all. In general with a fixed interspace the closer the cameras are to the object the more is the accentuation of depth, and the use of normal lenses for detailed closeups would be objectionable if carried to the extreme. But closeups are very satisfactorily obtained with telephoto lenses from more remote camera distances.

EDITING OF STEREOSCOPIC MOTION PICTURE FILMS

The editing of double system stereoscopic films presents special problems because of the fact that the two films must be cut in exact synchronism to the nearest frame throughout the whole length of the production. Should either film become broken or damaged, or require splicing for any reason at any time, each film should be cut at exactly the same frame and the same splice made in each.

The first step in editing new film is synchronization of the left and right footage without any particular regard to continuity. Since surgical footage usually is made in the correct time sequence, not much shifting of scenes will be necessary if the original reels are linked in correct chronological sequence.

The next step is to view one of the films and to cue preliminary cutting by means of notches or perforations punched into the center or edge of the film.

The two films are then set up on two rewind spindles and are drawn together to the cue marks, where the two are cut simultaneously and respliced as required. Constant check on synchronization is easily had by inspecting the start or end of individual scenes.

Next, one film is again viewed and further cutting is cued, after which addi-

tional cutting is done on the two reels. The process is continued until the sequence and tempo are considered optimum and satisfactory.

In order to make it easy to start the two films in step-in projecting it is convenient to attach white leaders at exactly the same frame at the beginning of each film. Also it is desirable to attach 8 or 10 inches of black opaque leader between the white leaders and the live footage.

TITLES

Titles may be made in any conventional manner, with this exception: It is usually necessary to photograph titles with the same cameras and the same mounting jig that were used to photograph the balance of the footage. If this rule is not observed, alignment difficulty may be experienced when the titles appear on the screen.

PROJECTION EQUIPMENT

Since polarized light is at present the most practical and satisfactory method of projection to large audiences, no other method will be discussed here. It is most desirable that high quality projection equipment be used. If large audiences are to be accommodated, with the required large screen, powerful projection lamps should be available. Five hundred or 750 watt projectors of high quality are available on the market and should prove satisfactory.

Suitable synchronizing means must be provided, so that the projectors run at exactly the same speed. Electrical means can be employed, but where a transverse high speed shaft is available on the projectors a simple mechanical connection is to be preferred. This should contain one or two universal joints to permit alignment of the images on the screen. If desired, a mounting base or a jig is not essential.

Figure 3 shows a pair of Ampro modeal KD projectors with synchronizing shaft in position. The shaft is detachable by simply pulling it out and the projectors can be packed in their usual individual cases for carrying.

Polarizing filters are attached over the lenses of the projectors. They may be attached rigidly and permanently or they may be mounted on a hinged member to permit them to be swung out of the way when nonstereoscopic film is being projected. Probably the simplest mount for the polarizers consists of standard filter rings intended for use on camera lenses. When filters are mounted this way, however, it is necessary that the orientation of the filter be carefully adjusted and maintained, especially after focussing.

The polarizing filters on the two projectors should be mounted with their axes 90 degrees apart. In this country some workers in stereoscopy have mounted the right polarizer vertically and the left horizontally, but more recently a technic of upright v mounting has been favored. In any event, the orientation of the polarizers on the projectors must correspond to the orientation of the polarizers in the viewing devices to be distributed to the audience.

The proper functioning of the polarizing method of viewing projected stereoscopic pictures depends upon the property of polarized light which permits transmission through a polarizing screen when the orientation is favorable, but eliminates transmission when orientation is unfavorable. If the beam from the left projector, which carries the film which should be visible to the left eye, passes through a polarizer 45 degrees to the left of vertical, the left eye of the viewer should be shielded by a polarizing screen oriented similarly, whereas the right eye of the viewer should be covered with a polarizing screen oriented 45 degrees to the right of vertical. The polarizer covering the right eye will then obscure the picture projected by the left projector. Meanwhile, the light beam from the right projector, which carries the picture intended for the right eye, should pass through a polarizing screen oriented 45 degrees to the right of vertical. This picture will be visible to the right eye but

not to the left. Thus selective viewing of the respective pictures for the left and right eyes is obtained.

teristics, aluminum has the additional advantage of being highly reflecting. The polarizing viewing technic reduces the light
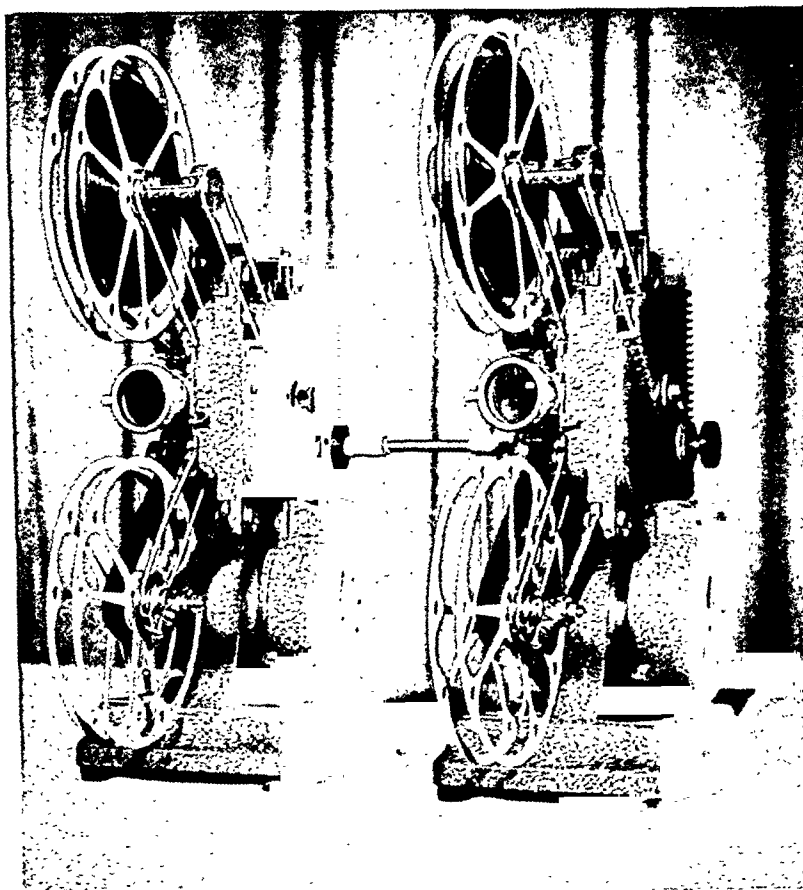

FIG. 3. Paired projectors with synchronizing shaft in position.

Choice of screen material is of importance. Many substances when illuminated with polarized light will reflect ordinary light and a screen made of such material would interfere with the functioning of the polarized viewing devices, so that each eye would see both images. The most satisfactory screen at present is probably a metallic surface such as aluminum. Aluminum for motion picture screens may possess rather poor diffusion characteristics which lead to a serious darkening of the image for persons attempting to view the pictures off to one side. To minimize this difficulty, the surface on which the aluminum is sprayed should not be too even, nor should the aluminum powder be too fine. In addition to the satisfactory polarized light charac-

to, perhaps, one-quarter of its normal value and the high reflectivity of the aluminum partially compensates for the loss.

PROJECTION

Except for the use of the special equipment discussed above, the projection of stereoscopic motion pictures is essentially the same as the projection of ordinary motion pictures. Large audiences can be accommodated and the equipment is portable and easy to set up. Polarized viewing spectacles must be used by every member of the audience. These must all have the same orientation, which must correspond to the orientation of the polarizing screens on the projectors.

Viewing from too far to one side will cause distortion in the stereoscopic image, just as in a flat picture. In placing the audience some consideration should be given to the diffusing capability of the screen material so that those off-center will not receive too dull an image.

It is well known that the perspective of a flat picture varies with the viewing distance. More striking is the variation in stereoscopic depth with viewing distance. The depth is least for persons near the screen, and may increase to tremendous proportions for those who may be twice or three times the projector distance. Although there is considerable tolerance in viewing, it is desirable to avoid placing anyone too close to the screen or too far away.

The images of the two projectors should be aligned as soon as they appear on the screen. Alignment can best be adjusted by viewing the screen without the aid of spectacles, when both images will be visible to each eye of the operator. The vertical alignment must be adjusted with great care, inasmuch as the eyes are most sensitive to error in the vertical angle; if the height of the two images should not be identical, suitable adjustment should be made to avoid eye strain. The lateral alignment or overlap is not so critical, because the human eye has more lateral tolerance than vertical. The projection masks should be adjusted so that they are of equal height on the screen. These masks will not ordinarily correspond laterally because of the toe-in of the cameras previously discussed.

When white leader is attached correspondingly to the left and right films as recommended above, synchronization at the time of threading is easily obtained by placing the splice at the end of the leader at the same position in the film gate of each projector. Synchronization will then be perfect for the duration of the footage projected, provided editing has been carefully carried out.

CONCLUSION

Stereoscopic motion pictures afford the natural method of viewing operative procedures, in other words, the visual effect obtained is exactly that of a two-eyed person watching the actual operation. As stereoscopic vision is natural for every individual with two good eyes, the advantages of stereoscopic motion pictures are obvious, particularly when immediate comparison is made with the customary flat or two-dimensional pictures. There is considerably less obstruction to vision by interposed hands and instruments, as the stereoscopic vision permits one to look around, so to speak, the intervening objects. Operations performed in deep body cavities are kept entirely in the field of vision with good focus, although care must be taken by the photographs not to exaggerate the depth. The greater detail and clearer vision of this method are useful in illustrating all operative technics even in flat surgical fields where the three dimensional effect is not so important, e.g., in neck dissection and thyroidectomy. It is our belief that stereoscopic motion pictures represent a distinct advance in the method of teaching operative technic. Examples of operations suitable for demonstration by this principle are the following: abdominoperineal rectal resection, partial and total gastrectomy, hysterectomy, right hemicolectomy, radical groin dissection, radical mastectomy, esophagectomy, pneumectomy, brain and intra-oral operations.

NEUROGENIC VESICAL DYSFUNCTION DUE TO SPINA BIFIDA AND MYELODYSPLASIA

TREATMENT BY TRANSURETHRAL RESECTION OF THE VESICAL NECK

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THE association of congenital abnormalities of the lumbosacral portion of the spinal column and sacral portion of the spinal cord with neurogenic vesical dysfunction has been known for many years and many investigators have contributed to our knowledge of this subject. Prominent among these are Virchow, who in 1875 was the first to employ the term spina bifida occulta, and Fuchs, who in 1909, in reporting a series of twenty-four cases of enuresis, was the first to employ the term myelodysplasia. Von Recklinghausen, in 1886, however, was the first to publish a really comprehensive discussion of this subject and Brickner, in 1918, the first to publish a large series of such cases. Subsequently others, particularly Chute, in 1921, Helmholz, in 1926, Campbell, in 1929, Mertz and Smith, in 1930, and Smith and Engel, in 1932, have published excellent articles on this subject as well as provided detailed reports of their respective series of cases.

That spina bifida occulta may be present without causing symptoms is well known. In fact, it is so common and so infrequently associated with symptoms that the suggestion has been made that it might be but a variation of the normal and not an anomaly. According to Woltman, "Roentgenologists believe that spina bifida occulta is so common that it may be considered a normal variation which has little or no bearing on the cause for which the patient is referred for examination." Mertz, among others, while of the opinion that spina bifida occulta seldom causes vesical dysfunction, nevertheless expressed the belief that such a lesion can, and occasionally does, affect the nerve supply of the bladder in such a manner as to interfere with its normal function. We are in accord with this point of view, granting that most cases of spina bifida occulta are without symptoms while acknowledging that in a small proportion of cases spina bifida occulta is probably the cause of the neurogenic vesical dysfunction. In our experience neurogenic vesical dysfunction is most likely to occur in those cases in which there is the most marked defect or greatest degree of deformity of the lumbosacral portion of the spinal column, and least likely to occur in those cases in which there are minimal defects. Exceptions to this rule, however, are fairly common. Occasionally, myelodysplasia of the cord may exist in the absence of any evidence of anomaly or deformity of the lumbosacral portion of the spinal column, but these cases are very uncommon. Woltman, in 1921, in his study of spina bifida, mentioned that it occurred only three times in his series of 187 cases.

CAUSATION

The manner of formation of spina bifida and other allied congenital anomalies of the lumbosacral portion of the spinal column is most interesting. According to Chute, "The bony defect of spina bifida is due to failure of the tissues of the mesoblast which forms the bony and muscular coverings of the cord to push in between the epiblastic tissues that form the spinal cord itself, and that part of the epiblast that forms the skin." The anomalous defect, once produced, results in the formation of abnormal spatial relationships

between the sacral portion of the cord and its nerves and the adjacent bony structures, and trauma to the cord and cauda equina may occur from undue traction or pressure on the structures of the cord. Frequently, in addition to the fusion defect of the osseous spinal column, there is a co-existing congenital or developmental defect of the sacral portion of the cord itself (myelodysplasia). Whatever be the lesion, however, whether a primary maldevelopment of the cord or secondary changes due to pressure or traction on the sacral nerve roots, the important consequence of the anomaly is a defective ("parasympathetic") innervation of the bladder.

There are many explanations offered of the disordered innervation of the bladder in these cases of congenital malformation of the lumbosacral portion of the spinal column. Elsberg, for instance, endeavored to explain the damage to the sacral nerve roots in cases of spina bifida occulta and spinal bifida cystica in somewhat the following manner: Ordinarily at the end of the third fetal month the cord extends down to the lower end of the spinal canal and as the individual grows the cord recedes until its lower end is about at the level of the first and second lumbar arch. If, therefore, the nerve roots are bound down to the lower end of the spinal column, as may occur should they be herniated through a dehiscence of the spinal column, they will undergo stretching as the disproportion of length between the bony and medullary columns develops with the growth of the individual. Penfield and Cone, in 1932, had somewhat the same idea in mind when they stated that the presence of a developmental spinal defect may prevent the normal progressive upward migration of the cord by incorporating the sacral nerve roots in a meningeal sac or by binding them down by abnormal fibrous bands.

Brickner, in 1918, called attention to the fact that it is not always the defect *per se* that is responsible for the symptoms, but rather an associated set of conditions.

He enumerated such a series of conditions which in his experience have accompanied spina bifida occulta and which have been responsible for the remote neuromuscular symptoms. They are as follows: (1) a distinct meningocele protruding through the bony cleft; (2) a closure of the cleft by a tough membrane adherent to the skin; (3) perforation of the membrane by a dense band attached to the subcutaneous tissues externally and compressing the cord structures internally; (4) fatty tissues lying within the canal concealed by this membrane; (5) a bulging of the dura mater; (6) an exostosis within the canal compressing the cord structures; (7) a myofibrolipoma extending through the cleft into the bony canal, compressing the cord and its roots; and (8) a degeneration of the cord tracts themselves. According to Findlay, writing in 1931, the fibrous tissue, which is occasionally responsible for pressure on the sacral roots, forms in an attempt to close the space between the gaping laminae to afford protection to the terminal portion of the cord. A superficial pad of fat resembling a lipoma often develops over the spinal defect as an added protection.

In addition to spina bifida, Burns and Helwig, in 1931, listed several other congenital abnormalities of the lumbosacral portion of the spinal column which may be associated with vesical dysfunction and relief from which may be obtained by appropriate treatment. Among these they included the following: (1) instability at the lumbosacral junction with dislocation or subluxation of the fifth lumbar vertebra, (2) increased lumbosacral angle or prespondylolisthesis and (3) spondylolisthesis. All three conditions may occasionally result in undue pressure on the cauda equina. To the foregoing list of deformities of the sacrum, Campbell added yet another, that of lateral displacement and angulation of the sacrum. In his experience it was the most commonly found anomaly other than spina bifida. Mertz and Smith, in 1930, summarized the influence of the structural defect on the vescial dysfunction

as follows: "The defect contributes to abnormal anatomical relations of the spinal cord and its membranes and may by adhesion or traction, by pressure due to a co-existing fibrous band, fatty tumor, a fibro-cartilaginous growth, or osteoma so disturb the physiological function of the subjacent nerves as to produce neurogenic vesical dysfunction."

NEUROPHYSIOLOGY

Though little question exists today that spina bifida and other abnormalities of the lumbosacral portion of the spinal column may interfere in some manner or another with the normal parasympathetic innervation of the bladder, there is, nevertheless, some difference of opinion as to the pathogenesis and character of the resulting neurogenic vesical dysfunction. According to Mertz, the mechanism of the vesical dysfunction is probably primarily purely irritative, the constant irritation affecting the vesical center of the cord and so altering its action that during sleep, when there is no psychic control, the bladder automatically empties itself. As the irritation continues or becomes more marked, there gradually develops a paralytic stage resulting in either retention or incontinence depending on the muscles affected.

Smith and Engel stated their impression that the disturbed parasympathetic innervation permits the influence of the sympathetic innervation to predominate, as a consequence of which partial or complete retention may occur. The presence of obstruction at the vesical neck, or absence of relaxation at this point, serves to stimulate the detrusor to compensatory hypertrophy and trabeculations develop. Complete retention, however, may eventually ensue, and later, as the degeneration of nerves progresses, the tone of the external sphincter is lost and active incontinence develops. Smith and Engel have pointed out that this last state of affairs is usually found associated with the most extensive types of defects in the lumbosacral portion of the cord. Burns and

Helwig in discussing their cases emphasized the rôle of pressure or of injury to the cauda equina and entirely omitted mention of the possibility of a co-existing primary congenital deficiency of nerve tissue, or myelodysplasia. They differed, however, with Smith and Engel in contending that the sympathetic system plays little or no rôle in the pathogenesis of the vesical dysfunction and based their conclusions on the fact that their cases exhibited a relaxed vesical neck both cystoscopically and cystographically.

Recently, a new conception of the cause of the vesical dysfunction has arisen. Denny-Brown and Robertson,[5,6] and Munro, as a result of their clinical studies on patients suffering from complete destruction of either the sacral spinal segments or the cauda equina, described a type of dysfunction which they referred to as the autonomous type of neurogenic vesical dysfunction or the so-called autonomous cord bladder. In this particular type of vesical dysfunction the all-important parasympathetic innervation of the bladder has been partially or completely destroyed and whatever activity does occur in the detrusor muscle and internal sphincter must apparently occur as a result of impulses transmitted through "a reflex arc whose afferent and efferent arms are both parts of a neural plexus that lies wholly within the vesical wall." Apparently this intramural mechanism exercises some control over the vesical contractions despite the fact that the bladder is, except for its sympathetic innervation, completely divorced from the central nervous system. This type of bladder, because of its self-governing or autonomous character, is spoken of as the autonomous or the autonomic stage of the "cord bladder."

According to Munro, however, the autonomous bladder is a very inefficient bladder whose detrusor contractions may be only sufficient to cause reciprocal relaxation of the internal sphincter and may not reach a size sufficient to produce emptying other than by leakage. Residual urine is

usually present. As an end result these bladders are described as being hypertrophied and incapable of storing any significant amount of urine. These patients have a practically constant urinary dribble. Inhibitory impulses do not reach these bladders from the higher centers and both the voluntary and the reflex activity of the external sphincter are absent.

Whereas Denny-Brown and Robertson,[5,6] in 1933, and Munro, in 1936, approached this problem from its clinical aspect, Langworthy and his co-workers, in 1936, approached it from its experimental aspect. They produced autonomous cord bladders in the cat by sectioning the sacral roots and noted, after the period of shock had passed off, that rhythmic contraction waves which did not show any tendency toward summation developed in the bladder. Possibly as a consequence of their more or less constant autonomous activity and heightened tone, the bladders of these animals underwent marked hypertrophy. Owing to the feeble and unsustained nature of the vesical contractions residual urine was usually present and the perineums of these animals were always more or less wet and edematous. One of us (C. E. J.), working with the dog, recently has confirmed Langworthy's findings.

It is apparent from this discussion that the autonomous bladder is a relatively inefficient organ, the expulsive mechanism has been seriously impaired and forceful sustained contractions of the detrusor are no longer possible. Furthermore, a factor of altered resistance at the vesical neck is present. Two explanations are currently being offered to account for this latter condition. The first is that in the bladder of the normal animal, as a consequence of contraction of the detrusor, a reciprocal relaxation of the vesical neck occurs. In the autonomous bladder, since a sustained contraction of the detrusor is no longer possible, reciprocal relaxation of the internal sphincter cannot occur (achalasia). The second explanation is that a mechanical obstruction actually develops at the

vesical neck as a consequence of the hypertrophy or of the hypertonicity of the detrusor muscle fibers at this point. There is much clinical evidence to support this point of view as many cases exhibit cellules and diverticula which would not ordinarily be expected to result from mere work hypertrophy (autonomous contractions) in the absence of obstruction of the vesical neck. Experimentally, the hypertrophy resulting from section of the sacral nerves is found to involve the entire bladder including the region of the internal sphincter.

While the defect in the innervation of the bladder in cases of anomalous defects of the lumbosacral portion of the spinal column usually involves both the motor and sensory divisions of the pelvic nerves and results in the autonomous type of neurogenic vesical dysfunction, it is possible for either division alone to be principally or exclusively involved, depending on the extent and nature of the spinal defect. If the posterior roots or sensory division is primarily involved an atonic type of neurogenic vesical dysfunction developes which resembles that seen in the tabetic bladder in which, as a result of impairment of vesical sensation, a gradual overdistention of the vesical musculature and gradual diminution or loss of explusive power occur. Involvement of the anterior roots of the sacral nerves, at least in the experimental animal, results in the autonomous form of neurogenic vesical dysfunction. Regardless, however, of the nature of the vesical dysfunction which ensues, the normal relation between the expulsive mechanism of the bladder and the so-called urethral resistance is altered and the function of the bladder is impaired.

SIGNS AND SYMPTOMS

The presence of a tumor at the lower end of the vertebral column may suggest the cause of the vesical dysfunction but more often than not, no such telltale sign is present. Often there is no external evidence whatsoever of a congenital defect in

the lumbosacral portion of the spinal column and one must rely entirely on the roentgenologic findings to reveal the presence of the defect. Occasionally, however, one or more of the following signs may be present and may provide a lead to the proper diagnosis: (1) a palpable defect in the lumbosacral portion of the spinal column, a depression in the sacrum, or merely a deep coccygeal fossa, (2) a fine white scar or a dimpling of the skin over the site of the defect, (3) a small tumor or a diffuse lipoma over the sacrum, (4) a pigmented area, nevus or area of telangiectasis over the lumbosacral portion of the spinal column, (5) hypertrichosis or a tuft of hair over the lower end of the vertebral column, (6) neurologic changes in the perineum and lower extremities, (7) deformities of the feet and lower extremities, as clawfoot, and finally, if graphic evidence is deemed essential, (8) compression of the dural cul-de-sac as shown by the roentgenogram following subdural injection of radiopaque oil.

The symptoms of neurogenic vesical dysfunction arising from congenital defects of the lumbosacral portion of the spinal column are those of enuresis, incontinence, either of the intermittent or of the constant variety, and retention of urine, either partial or complete. Though the symptoms may vary somewhat from case to case, incontinence in some form or another is usually present. Eleven of Mertz and Smith's thirteen cases presented incontinence of urine as their most outstanding symptoms, and nine of these cases presented some evidence of retention of urine as well. Nine of Smith and Engel's thirteen cases manifested frank incontinence unassociated with retention of urine. In their remaining four cases the patients were able to void small amounts of urine with great difficulty. Chute expressed the opinion that though the symptoms presented by ordinary cases of spina bifida might vary considerably they were usually associated with marked sensory and motor disturbances of the lower extremity, as

clubfoot, ulcers of the foot and similar trophic disturbances. Campbell expressed more or less the same opinion, stating that the nerve lesion associated with spina bifida was often manifested by loss of control not only of the vesical and rectal sphincters but also of the muscles of the legs. It was also his impression that in a number of cases of co-existing spina bifida and vesical dysfunction without cutaneous sensory changes, the etiologic relationship might be exceedingly difficult to establish.

It should be emphasized that the onset of symptoms, particularly among older children and young adults, may be insidious. In some cases neither the patient himself nor the parents are aware of the development of urinary difficulty and it is only when recurring or resistant infection develops that further investigation reveals the presence of residual urine. At that time even casual inquiry will bring out the fact that the patient has been straining considerably to void and that urination is accomplished only in an intermittent fashion. However, in some cases the patient has been unaware that his stream was abnormally small and he is loath to believe that residual urine is present. Among infants the vesical dysfunction is evident by suprapubic pain and rigidity at the time of urination. In one of our cases the pain was severe enough to demand catheterization several times each night. Only in this manner could the child be relieved. Recurring chills and fever may be the cardinal signs and only when the persistent pyuria is investigated is the entity being discussed discovered.

We wish to stress the fact that symptoms in many instances are not present at birth but develop much later, occasionally as late as the second or third decade of life. Some of our patients had been accused of a neurosis or of hysteria as the basis of urinary retention. Pains in the suprapubic region, apparently due to vesical spasm associated with the dysfunction, are commonly noted, especially after infection has supervened.

TREATMENT

It is apparent from this discussion that several approaches to the problem of treatment are possible. Chute, in 1921, stated the problem as follows: "As the cause of the situation in these cases is probably due to a mechanical interference with the fibers. of the cauda equina, it is useless to look for permanent relief by any means other than attacking the problem mechanically at the point where the interference has taken place." Brickner, at an earlier date had performed an exploratory operation in many of his cases, but finally reached the conclusion that "taken all together, the results of operation for spina bifida are not brilliant, and probably for the reason that the degenerative and neoplastic processes are scarcely remediable."

Campbell, in 1929, stated his impression that "treatment in these cases is most unsatisfactory and the attainment of a cure unlikely. In the majority of advanced cases the most one can do is to recognize the nature of the lesion, inform the patients of the true situation, and offer as much comfort as possible to the patient, bearing in mind that even in the presence of extreme renal destruction he may live for some years if an acute infection does not supervene." Campbell suggested that in the less severe cases, those manifested clinically by marked enuresis or partial incontinence, atropine may possibly be of benefit. More recently he has resected the vesical neck with a view toward eliminating the residual urine. Mertz and Smith, in 1930, mentioned several cases in which a successful result was obtained by release of traction or pressure on the structures of the cord. Aside from surgical exploration of the defect of spinal fusion, they added that the only other types of treatment available were those intended to overcome the existing infection such as "urinary antiseptics, the indwelling urethral catheter, pelvic lavage, permanent suprapubic cystostomy, plastic operations upon the ureter and pelvis, and ureteral transplanta-

tion." In the last type of treatment mentioned a competent anal sphincter must first be established before the operation is undertaken.

Burns and Helwig, in 1931, expressed the opinion that both orthopedic and urologic measures need to be instituted. Among the former they included the use of braces, stabilization of the lumbosacral portion of the spinal column with spinal fusion, and laminectomy with the relief of pressure on the cord. Among the latter they mentioned the use of urinary antiseptics and urethral dilatation. Smith and Engel, in 1932, suggested that patients suffering from incontinence be first given the benefit of an attempt at correction of the neurologic defect, after which correction of the relaxed sphincter by plastic means may be tried. This may be accomplished by means of Young's intravesical operation on the vesical neck or by transplanting the gracilis muscle. For those cases in which there is retention they have advocated the use of dilatation of the vesical neck, to be followed, if necessary, by exploratory laminectomy or presacral neurectomy or both.

McCarroll, in 1937, expressed the opinion that most cases of incontinence due to spina bifida fall into types in which "marked improvement and often perfect control can be expected from simple conservative measures alone," and that surgical intervention is not indicated in the majority of instances. By initiating a program of having his patients abstain from fluids after five in the afternoon and voluntarily void by straining every one to four hours during the day and as often as necessary during the night, he was able to eliminate their diurnal and nocturnal incontinence. If the patient's vesical capacity was unusually small it could often be increased by periodic vesical dilatations.

Recently, Nesbit and Gordon reported the successful use of transurethral resection of the vesical neck in two cases of autonomous vesical dysfunction. Both of their patients were men, aged eighteen and

thirty-five years, respectively. Examination had revealed a congenital defect of the lumbosacral portion of the spinal column and the symptoms of urinary difficulty had been present since birth.

One of us (G. J. T.) has had occasion to see a fairly large number of patients suffering from neurogenic vesical dysfunction arising as a result of myelodysplasia and spina bifida. Many of these patients were children who had been brought to the Mayo Clinic because of a chronic infection of the urinary tract, and who complained only of chills, fever and cloudy urine. Others had been brought because of poor control of the bladder and complained of enuresis, incontinence or retention. In many of these cases at the time of examination at the clinic dilatation of the upper part of the urinary tract had already developed. Formerly some of these patients underwent surgical exploration of their lumbosacral defect and an attempt usually was made at correcting the anomaly. Unfortunately, the majority of these patients had irremediable lesions and little was accomplished by the operation. Occasionally, to be sure, a very satisfactory result would ensue, but this was the exception rather than the rule.

Cystoscopic examination of the bladders of these patients, most of whom were children, usually revealed definite trabeculation of the detrusor and raised the question of the possible presence of a co-existing obstruction of the vesical neck. Frequently, and particularly when the bladder was distended, a rim of muscular tissue could be found extending around the circumference of the internal vesical orifice. When the bladder is distended, this tissue becomes quite spastic, contracting down to a small fraction of its former diameter in true iris diaphragm style. (We think that it is this entity which has for years been mistakenly called a type 3 congenital valve.) Trabeculations appear on the distended wall of the bladder at this stage of the examination and the urethra distal to the spastic portion of muscle surround-

ing the vesical neck also becomes distended, forming an asymmetric hourglass. The examination should be made with a panendoscope because the beak of instruments of other types will interfere with the contraction of the musculature of the vesical neck. On occasions the spastic tissue will be confined to one lip of the orifice.

In rare instances patients suffering from this disease are benefited by dilatation alone. Such patients are no doubt seen very early in the course of the development of vesical dysfunction and we believe that after a period of years mechanical obstruction requiring operation will develop.

Early in our experience in transurethral surgery it seemed logical that excision of tissue from the vesical neck in cases of vesical dysfunction due to spina bifida might be beneficial. It was conceivable that abnormal tissue in this location would cause obstruction to the egress of urine no matter what the etiologic factor; therefore, tissue was resected in the early cases we encountered, using a punch designed for the treatment of infants. Microscopic examination of the tissue removed in this manner revealed it to be hypertrophied smooth muscle. As a result of the removal of only a few pieces of tissue, the ability to void was considerably improved, the residual urine was lessened or entirely abolished, and the infection could be more easily controlled. As a consequence of this early and favorable experience with this method, it has been used more and more extensively, in fact, almost to the exclusion of any other method of treatment. Chemotherapy is employed in these cases before and after operation in an effort to control or eradicate the invariably present infection of the urinary tract.

As may be expected, the best results were obtained in the cases in which the symptoms were of comparatively recent onset, or those in which there was minimal damage to the urinary tract, and the poorest results were obtained in those cases in which there were prolonged symptoms and extensive damage to the upper part of

the urinary tract. In a few instances, however, an excellent result has occurred in advanced cases, possibly mainly as a result of lessening back pressure in the kidneys, thus permitting eradication of infection. As may also be expected from an understanding of the nature and pathogenesis of the dysfunction, permanent relief may not always be obtained and re-resection may occasionally be required. It is important, in our opinion, to resect tissue from the entire circumference of the vesical neck, making an effort to remove all muscular tissue which projects in any way into the lumen. Temporary relief was obtained in some of our early cases by fulguration and incision. These patients subsequently returned for further operation.

An inlying catheter should, of course, be used postoperatively to control bleeding and put the bladder at rest. The immediate result of operation is usually excellent and the patient is delighted with his ability to void. Control at this time is usually better than it may be subsequently.

Education of the patient in how and when to void is extremely important. He will be able to empty his bladder without much effort as a rule but if he does not follow a schedule, retention may develop again. A regimen somewhat like that which McCarroll has advocated is very desirable postoperatively.

CASE REPORTS

CASE I. The patient, a boy, aged two and a half years, was referred to the clinic for treatment of a chronic infection of the urinary tract characterized by urinary frequency, enuresis, chronic pyuria and recurring attacks of chills and fever. Examination elsewhere had revealed a postanal dimple and roentgenologic examination had revealed an underlying spina bifida. Residual urine had varied from 500 to 700 cc. An excretory urogram had revealed extensive dilatation of the ureters and kidneys, graded 3 to 4 (on the basis of 1 to 4, in which 1 designates the least and 4 the greatest dilatation). At the time of admission the patient had had an indwelling catheter in for three weeks.

General examination showed a fairly well developed male child. Urinalysis revealed moderate pyuria with Gram-negative bacilli. The concentration of urea in the blood was 52 mg. per 100 cc. An excretory urogram revealed marked dilatation of the upper part of the urinary tract while a retrograde cystogram revealed an irregular vesical outline partially obscured by hugely dilated ureters.

At cystoscopic examination an atonic bladder with numerous cellules was found. Both ureteral orifices were markedly dilated. Though there was not much obstructing tissue seen, a ridge-like protrusion of tissue was found on the right side of the internal sphincter and this was thought to be a factor in preventing relaxation of the sphincter. Valves were not present.

Transurethral partial sphincterectomy with the removal of several pieces of tissue was performed. The pathologist reported inflammatory tissue. Residual urine at dismissal was 20 to 30 cc.

This child had been quite well at the time of writing for seven years with no further recurrence of his former urinary symptoms. His development, as reported by his local physician, had been normal. No further word had been received regarding the state of the upper part of his urinary tract.

CASE II. The patient was a boy, aged ten years, whose past history had been uneventful. Pain in the back had developed one month prior to admission. A local physician had found pyuria. An excretory urogram at home suggested "polycystic kidneys."

General examination revealed an alert, active boy. The blood pressure was 142 mm. of mercury systolic and 104 diastolic. The bladder was palpable above the symphysis. Pyuria was graded 2 to 3. Micrococcus was present in the urine. The concentration of urea in the blood was 28 mg. per 100 cc. An intravenous urogram showed a functionless right kidney with no evidence of dye in the sixty-minute film. The left kidney presented pyelectasis and caliectasis graded 4 with fair function. The urogram suggested that very little cortical tissue remained. A diagnosis of spina bifida occulta of the fifth lumbar and first sacral vertebra was made.

Suprapubic cystostomy was performed, followed in one week by sphincterectomy. There was no evidence of congenital valve formation.

The vesical neck seemed to be slightly smaller than normal with several tags of granulation tissue projecting particularly from the anterior half. Several pieces of tissue were excised from the posterior vesical lip and the tags of granulation tissue were coagulated.

There was 15 cc. of residual urine at the time of dismissal. An excretory urogram one week after operation revealed some evidence of function on the right in the twenty and forty-five minute films, with pyelectasis and caliectasis graded 4.

When the patient returned three months later for recheck of the vesical neck it appeared normal. There was no tissue that could be removed or fulgurated. An intravenous urogram revealed bilateral hydronephrosis graded 4 as formerly.

Six years later the patient's mother reported that the patient had not had any further urinary trouble and recently had been chosen a member of the all conference high school football team.

CASE III. The patient was a man, aged twenty-seven years. His past history was unremarkable. He had been well until four months before coming to the clinic when pain developed in the bladder, aggravated by urination. Gradually, difficulty developed in starting the stream with variable frequency (four to fifteen times) and nocturia (two to five times). There was occasional nocturnal incontinence. Urinalysis revealed pyuria and hematuria. The condition had been treated with sulfathiazole with no improvement. Cystoscopy had revealed a normal upper part of the urinary tract and "an anomalous condition of the posterior urethra." Though the patient had not had any chills, a low grade fever was present most of the time.

General examination showed a well developed man with "short disproportionate feet." Neurologic examination revealed saddle anesthesia of the perineum and relaxation of the rectal sphincter, graded 3. The blood pressure was 120 mm. of mercury systolic and 78 diastolic. The prostate was soft and enlarged, grade 1. The urine revealed only an occasional pus cell. The concentration of urea in the blood was 24 mg. per 100 cc. A roentgenogram of the lumbosacral portion of the spinal column revealed a congenital anomaly of the sacrum with bifurcation and sacralization of the last lumbar transverse process.

Cystoscopic examination showed 520 cc. of residual urine and acute cystitis with many points of hemorrhage. The expulsive force appeared normal. There was some questionable decrease of sensation. Moderate trabeculation and cellule formation were present. The internal vesical sphincter appeared to be dilated grade 2 and the verumontanum was hypertrophied.

Transurethral partial sphincterectomy was performed with the removal of 4 Gm. of tissue from the entire circumference. The pathologist reported adenomatous hyperplasia of the prostate. Sulfathiazole was administered. The residual urine was 90 cc. at the time of dismissal.

Since the operation the patient has had much less difficulty in voiding and has "better control."

CASE IV. The patient, a man aged thirty-two years, was born with an "open sore" overlying the base of the spinal column which took many months to heal. Walking had always been complicated by the presence of bilateral pes cavus. Occasional rectal incontinence had been present, especially when his stools were loose. A local physician found "cyst of spine" and noted sensory and trophic changes in the lower extremities.

The patient came to the clinic because of increasing difficulty during the previous four years in voiding satisfactorily and because of several attacks of acute retention requiring catheterization. General examination showed a well developed and well nourished man who had bilateral pes cavus or callositas. An old scar was present over the lumbosacral portion of the spinal column. The blood pressure was 126 mm. of mercury systolic and 70 diastolic. Urinalysis revealed moderate pyuria. The concentration of urea in the blood was 20 mg. per 100 cc. Neurologic examination revealed a weakness of both legs with diminished sensation over both feet. The left patellar reflex was decreased. A roentgenogram (Fig. 1) of the lumbosacral portion of the spinal column revealed spina bifida of the fifth lumbar vertebra and entire sacrum with considerable deformity of the body of the fifth lumbar vertebra.

On cystoscopic examination the bladder was quite spastic and contained 90 cc. of residual urine. There was definite hypertrophy of the internal sphincter with moderate trabeculation and multiple cellules. Expulsive force and

sensation appeared grossly normal. The hypertrophy of the internal vesical sphincter simulated a medium bar with slight contracture of the vesical neck.

Transurethral resection of the vesical neck was performed with the removal of 6 Gm. of tissue from the entire circumference. The pathologist reported glandular hyperplasia and hyperplasia of muscle. An excellent postoperative result was immediately obtained and the patient has continued to void easily with no residual urine for the past four to five months.

CASE V. The patient, a man aged fifty-two years, was born with bilateral club feet. The right foot improved with treatment but the left remained unchanged. At the age of twenty-one years he noticed progressive atrophy and weakness of the left lower extremity with the development of a limp requiring the use of a cane. At the age of seven years he had typhoid fever, during which acute urinary retention developed. He was never able to void after this and has had to catheterize himself three times a day ever since. There was occasional fecal incontinence with cathartics. One year prior to admission discomfort and a sensation of fullness in the perineum had developed. Three months prior to admission pain in the lower part of the abdomen and urethral discharge developed. Shortly prior to entering the clinic the patient had chills and fever and felt poorly.

General examination showed partial atrophy of the left lower extremity, bilateral club feet and an atonic rectal sphincter. The prostate gland was hard and probably malignant. Pyuria was graded 4 with gram-positive cocci. A culture of urine was sterile. A roentgenogram of the spine revealed a congenital deformity of the sacrum. An excretory urogram (Fig. 2) revealed bilateral pyelectasis, caliectasis and ureterectasis, graded 3 to 4, with apparent partial obstruction to the lower part of the ureters. The concentration of urea in the blood was 28 mg. per 100 cc.

Cystoscopic examination showed an ulcerating carcinoma of the prostate which was quite obstructive and which had caused considerable trabeculation of the bladder.

Transurethral prostatic resection was performed with the removal of 33 Gm. of tissue, which opened the bladder neck and prostatic urethra widely. The pathologist reported squamous cell epithelioma, grade 3 (Broders' method).

After operation the patient was relieved

FIG. 1. Plain roentgenogram of region of kidney, ureter and bladder. Note failure of fusion and deformity of the posterior laminae of the fifth lumbar vertebra and complete absence of fusion of the posterior laminae of all the sacral vertebrae.

of the need for catheterization. Later incontinence developed for which he wore a clamp. He was given roentgen therapy and stilbestrol with no improvement. Gradually progressive pyelonephritis and uremia developed and the patient died eight months after operation, apparently of gradual ureteral occlusion by the carcinoma of his prostate.

CASE VI. The patient was a girl, aged two years. A small fatty tumor had been present over the left buttock at birth. She walked at nine months. She had been apparently well until pyelitis developed at one year. There had been no response to sulfanilamide. An excretory urogram had been reported to show bilateral hydro-ureter and hydronephrosis. At fifteen months the tumor on the buttocks had been excised, the pathologist's report being "a fat tumor with many nerve fibers." Following operation rectal incontinence had developed.

The patient's symptoms when she was brought to the clinic were diurnal and nocturnal urinary incontinence and frequency, pyuria,

There was 7 to 8 fluid ounces (210 to 240 cc.) of residual urine.

Transurethral partial sphincterectomy was

FIG. 2. Fifty-five minute excretory urogram. Note failure of fusion of the posterior laminae of all of the sacral vertebrae and the malformation and malposition of the sacrum. Bilateral hydronephrosis.

rectal incontinence and recurring periods of chills and fever. General examination revealed a well developed and well nourished child save for fullness or unusual prominence of the left buttock and partial atrophy of the left lower extremity. The rectal sphincter was relaxed. The patient was incontinent of urine with 4 to 6 fluidounces (120 to 180 cc.) of residual urine. The urine was loaded with pus and contained Escherichia coli. The concentration of urea in the blood was 28 mg. per 100 cc. The blood pressure was 110 mm. of mercury systolic and 70 diastolic. Neurologic examination revealed saddle anesthesia of the perineum. Roentgenologic examination of the lumbosacral portion of the spinal column revealed a congenital anomaly of the sacrum.

Cystoscopic examination showed marked trabeculation of the bladder with spasm of the vesical neck, particularly of the posterior vesical lip, when the bladder was distended.

performed with the removal of "several pieces" of tissue, the pathologist's report of which was "inflammatory tissue." Regular small doses of sulfathiazole were administered.

The patient fared well postoperatively for approximately eight months, during which time her residual urine varied from 1 to 2 fluid ounces (30 to 60 cc.). Subsequently, however, her residual urine gradually increased to 4 to 8 fluid ounces (120 to 240 cc.) and she was brought back for re-examination. Cystoscopic examination revealed a recurrence of the former spasticity of the internal vesical orifice and eleven small pieces of tissue were removed from the entire circumference. The pathologist's report was inflammatory muscle and mucous membrane. Following this second operation her residual urine has remained at approximately 1 fluid ounce (30 cc.). The rectal incontinence has persisted, but the dribbling and overflow incontinence have been

much improved. No further chills or fever has
ensued and the urine has been kept fairly
clear by means of chemotherapy.

CASE VII. The patient, a girl aged eleven
years, had suffered since birth from pyelo-
nephritis with recurring chills and fever and
constant pyuria. A diagnosis of spina bifida
had been made for which presacral neurectomy
had been done with no apparent improvement.
Neither ketogenic diet nor chemotherapy had
been successful in controlling the infection.

At the time of admission to the clinic the
patient complained of chills, fever, cloudy
urine, occasional dysuria, straining to void
and occasional pain in the lower left quadrant
of the abdomen. General examination showed a
mass over the left buttock and sacrum, sug-
gestive of spina bifida. Pyuria was graded
2 to 4, and the urine contained Streptococcus
faecalis and hemolytic streptococci. The con-
centration of urea in the blood was 44 and
48 mg. per 100 cc. The blood pressure was
105 mm. of mercury systolic and 60 diastolic.
Residual urine was not determined. The
neurologic diagnosis was spina bifida and
myelodysplasia with neurogenic vesical dys-
function. Roentgenologic examination of the
lumbosacral portion of the spinal column was
reported as showing an apparent anomaly of
development of the coccygeal segment. An
excretory urogram revealed bilateral hydro-
nephrosis and hydro-ureter, grade 4, with
bilateral reduction of function.

On cystoscopic examination the expulsive
force appeared excellent though the inner
portion of the internal vesical sphincter
seemed to elevate when the detrusor con-
tracted. No apparent hypertrophy of the
internal vesical sphincter was noted.

Transurethral partial sphincterectomy was
performed with the removal of multiple bits of
tissue, the pathologist's report of which was
"inflammatory tissue." Sulfathiazole and man-
delic acid were administered alternately. The
residual urine ten days after operation was
15 cc.

Three months after operation the child
voided much more easily and, though occa-
sionally damping her clothes in the daytime,
did not have any leakage at night. The residual
urine was 60 cc. Cystoscopy revealed some
persistent slight elevation of the posterior lip.
Recently (eighteen months after operation)
this patient was re-examined and the vesical

neck was found to be quite flexible. The ureteral
orifices were not as dilated as formerly and the
urine was essentially normal. Since her residual
urine had increased to 90 to 120 cc. the vesical
neck was dilated with the Kollman dilator and
following this the residual urine decreased.
At the time of her dismissal she was able to
control her urine perfectly unless she allowed
her bladder to become overdistended.

CASE VIII. The patient, a woman aged
twenty-four years, had been born with spina
bifida. She had walked at eighteen months
though she always suffered from impediment in
walking. Bilateral pes cavus, and many
trophic ulcers of both feet developed. One
toe had been amputated for failure to heal.
Tendon operations had been performed on
both feet to assist her in walking. Constipation
had been very troublesome and required the
regular use of laxatives.

The patient came to the clinic because of her
inability to void, having been catheterizing
herself three times daily for the past fifteen
years. She also complained of lack of desire
to void and of occasional incontinence with
excitement. The urine was frequently cloudy.
No chills or fever had been present.

At general examination a swelling of the soft
tissue was present over the lower part of the
spinal column, beneath which was a palpable
defect of the fourth and fifth lumbar vertebrae.
There was a cavus deformity of both feet and
many calluses, ulcers and scars. The blood
pressure was 114 mm. of mercury systolic and
70 diastolic. The rectal sphincter was tight.
Neurologic examination revealed saddle anes-
thesia of the perineum, absent tendon reflexes
and diminished sensation in both lower extremi-
ties. Urinalysis revealed mild pyuria and
Escherichia coli bacilluria. Roentgenologic
examination (Fig. 3) of the lumbosacral portion
of the spinal column revealed that the fourth
and fifth lumbar and all the sacral arches were
open.

At cystoscopic examination the residual urine
was 300 cc. There were marked trabeculation
and diminished sensation and expulsive force.
The internal vesical sphincter appeared fixed
and hypertrophied with slight relaxation.

Transurethral partial sphincterectomy with
the removal of several bits of inflammatory
tissue was performed. There was little evidence
of hypertrophy of the internal sphincter. The
patient voided well following this procedure

but did not empty her bladder. Accordingly, a second resection was performed two weeks later and several more pieces of tissue were
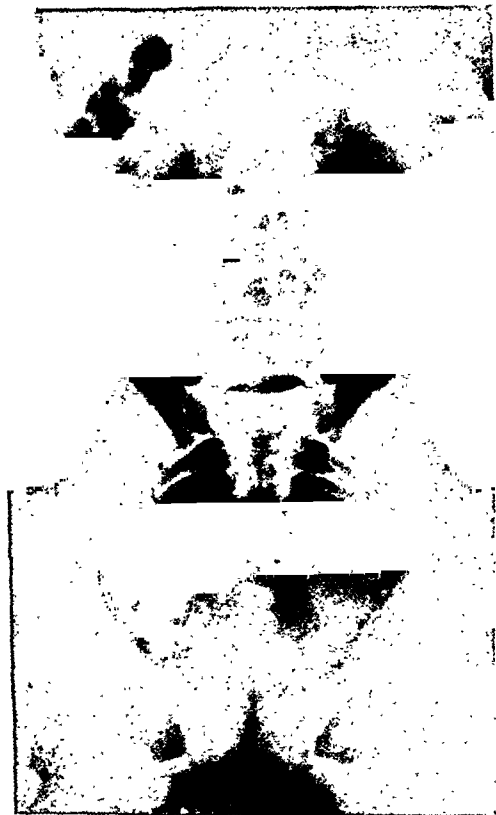

FIG. 3. Plain roentgenogram of region of kidney, ureter and bladder. Note the failure of fusion of the posterior laminae of the fourth and fifth lumbar vertebrae and all the sacral vertebrae.

removed from the entire circumference of the vesical neck. The residual urine at dismissal was 45 cc.

The patient has been able to void satisfactorily for the past four years, using her abdominal and diaphragmatic muscles to assist in the act. It has not been necessary to re-employ the catheter. The urine has remained clear.

CASE IX. The past history of the patient, a woman aged thirty-one years, was unremarkable. She came to the clinic complaining of chronic cystitis of twelve years' duration, characterized by severe urgency, frequency, dysuria and suprapubic pain.

General examination showed a well developed and well nourished woman, who had cystocele, grade 1, and rectocele, grade 1. The blood pressure was 145 mm. of mercury systolic

and 75 diastolic. Urinalysis revealed pyuria, grade 4, with Aerobacter aerogenes bacilluria. The concentration of urea in the blood was 26 mg. per 100 cc. Neurologic examination gave objectively negative results except for slight anesthesia about the labia. The rectal tone was good. Roentgenologic examination (Fig. 4a) of the lumbosacral portion of the spinal column revealed a congenital anomaly of the sacrum and coccyx with lack of development of the lower right half of the sacrum. An excretory urogram revealed slight cicatricial changes in both kidneys. A retrograde cystogram (Fig. 4b) revealed an irregular vesical outline with sacculations and cellules. The residual urine on three occasions was 150, 150 and 200 cc.

Cystoscopic examination showed moderate hypertrophy and thickening of the internal vesical sphincter and marked trabeculation, grade 4. Sensation and expulsive force were normal.

Transurethral partial sphincterectomy was performed with the removal of twenty pieces of tissue from the entire vesical neck. The pathologist reported inflammatory tissue. Residual urine at dismissal was 10 cc.

CASE X. The patient, a woman aged thirty-five years, had been well until three years before coming to the clinic when urinary retention developed with pyuria and recurring chills and fever. There was 1,000 to 1,200 cc. of residual urine on several occasions.

Neurologic examination gave essentially negative results. The rectal tone was normal. The blood pressure was 110 mm. of mercury systolic and 76 diastolic. Urinalysis revealed pyuria grade 2 to 3, with Escherichia coli bacilluria. The concentration of urea in the blood was 16 mg. per 100 cc. A cystometrogram revealed a shift to the right (with diminished sensation and first desire to void at 520 cc.). A roentgenogram of the lumbosacral portion of the spinal column revealed spina bifida occulta of the first sacral vertebra.

Cystoscopic examination showed 300 cc. of residual urine. The bladder appeared to be atonic with no evidence of either obstruction of the vesical neck or trabeculation.

Exploratory laminectomy with removal of fibrous bands compressing the cauda equina was performed. As this did not produce any relief of symptoms, resection of the presacral nerve was performed six weeks later, again with no relief of symptoms. Transurethral sphincter-

otomy was performed five months after resec-
tion of the presacral nerve, the Collings knife
being used to incise the sphincter on each side
of the floor of the urethra.

reported. Five patients were males whose
ages ranged from two to fifty-two years
and five were females whose ages ranged
from two to thirty-five years.

Fig. 4. a, plain roentgenogram of region of kidney, ureter and bladder. Note the marked mal-
formation and malposition of the sacrum, with complete failure of fusion of the second, third,
fourth and fifth sacral vertebrae; b, cystogram exhibiting retention type of bladder with cellules
and diverticula.

After the third operation the patient was well
for one year when symptoms of cystitis re-
turned. There was 20 to 30 cc. of residual urine.
Local treatment in the form of vesical lavage
was successful and the patient was well for five
years, when her former symptoms of retention
and infection recurred. Cystoscopic examina-
tion revealed a contracture of the vesical neck.
Dilatations of the vesical neck again afforded
relief of the patient's symptoms.

SUMMARY

Ten cases of neurogenic vesical dysfunc-
tion due to congenital anomalies of the
lumbosacral portion of the spinal column
and spinal cord in which transurethral
resection of the vesical neck had been per-
formed with relief of symptoms have been

The presenting symptoms of the ten
cases of neurogenic vesical dysfunction
were quite variable. Four patients com-
plained of chronic urinary retention neces-
sitating periodic catheterization while two
complained of recurring acute urinary
retention. Two complained of complete
loss of control of urination with an active
type of incontinence. Three complained
of vesical irritability with frequency and
dysuria while four complained of recurring
chills and fever and chronic pyuria.

An apparent obstruction was seen cysto-
scopically in eight of the ten cases while in
the remaining two cases no obstruction was
evident. In both of these cases, however,
the patients were relieved of their symp-

toms of obstruction by resection of the vesical neck. In seven of the cases either trabeculation or cellule formation or both were evident while in the remaining three cases the presence or absence of trabeculation and cellules was not recorded.

Partial or complete sphincterectomy was performed in five cases while resection of the vesical neck and obstructing prostatic tissue (4, 6 and 33 Gm.) was performed in three cases. Sphincterotomy or mere incision of the internal vesical sphincter was performed in two of the early cases. There were no operative deaths though one patient died eight months after operation from pyelonephritis and uremia.

Five of the patients were greatly improved, four were improved, and one was temporarily improved. The following conclusions have been drawn:

1. Transurethral resection of the vesical neck lessens the urethral resistance and reduces or abolishes the residual urine.

2. Elimination of the residual urine and control or eradication of the infection of the urinary tract in these cases serve to preserve the anatomic integrity and functional efficiency of the upper part of the urinary tract.

3. A rigid postoperative regimen of routine voiding by the clock and of abstaining from fluids in the evening should be instituted.

4. In the majority of cases great improvement in urinary function has resulted from the operation; in some cases normal vesical function has been restored.

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PLASTIC SURGERY IN THE TREATMENT OF WAR CASUALTIES*

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THE term, plastic surgery, is somewhat misleading but has become so well established that change is difficult. Since the first world war the term, "maxillofacial surgery," has been used in the medical services of the army and navy. This would suggest that plastic surgery is limited to the jaws and face. Reconstructive surgery is a better term. Staige Davis, whom Sir Harold Gillies recently described as the "grandfather of plastic surgery in America," defines plastic surgery as that branch of general surgery which has to do with the reconstruction of injured, lost or deformed parts all over the body, and is concerned primarily with restoration of function and secondarily with improvement of appearance. At the close of the previous war plastic surgery was being done for the most part by men with dental or ear, nose and throat training. Today it is generally recognized as a special branch of general surgery requiring thorough training in general surgery and a working knowledge of several other specialties. The American Board of Plastic Surgery was set up in 1939. A committee of this Board and the two plastic surgery societies, of which Dr. Gordon New of the Mayo Clinic is chairman, has completed a survey of existing facilities for the study of this subject. This survey shows that these facilities are inadequate for peace times. Now that all types of residencies have been sharply limited, training in plastic surgery will be almost nonexistent. This is a serious situation in view of the fact that only about 125 surgeons have been certified by the American Board of Plastic Surgery.

To quote from the Manual of Plastic and Maxillofacial Surgery prepared by the National Research Council and the Medical Department of the U. S. Army,[1] "The Casualty from the field of battle has a right to expect and demand the optimal result which can accrue from a highly cooperative professional service and a skill which results from the utilization of all that is best in the general and special experience related to his particular problem. His future mental comfort and success in the competition of living will be materially influenced by his facial function and appearance." The preliminary treatment of the casualty determines to a large extent the outcome of later reconstruction. Prompt local hemostasis, pressure bandages, use of small hemostats and fine ligatures, conservation of bone fragments which are attached and soft tissue which is viable—all these points should be kept in mind as the casualty passes from the Battalion Aid Station through the Clearing Station and Evacuation Hospital.

The medical officer is often faced with medical or surgical situations with which he must deal without consultation or assistance. He should be acquainted with the principles of reconstructive surgery. He should know how to close wounds of the face and when to leave them open. A skin graft is often the best dressing for a wound. He should be able to cut and apply the simpler types of skin grafts and care for them. The early local treatment of a severe burn will determine to a large extent the time required for healing and the degree of permanent disability.

After the casualty has been removed from the combat zone and has recovered from shock a complete examination can be made and treatment outlined. Fractures of

the facial bones with displacement can frequently be determined before x-ray examination if swelling and tenderness are not too great. Bilateral palpation of the face bones from above downward is helpful. The order of frequency of fracture of the facial bones is: mandible, nose, zygoma, maxilla and multiple fractures. Failure to reduce a fresh fracture requires extensive surgical measures later, but it can be reduced within the first two or possibly three weeks. These fractures should not be manipulated and the nose should not be packed in the presence of cerebral fluid drainage. Delay reduction for at least ten days after drainage ceases.

The nose is the most prominent facial feature. Marked abnormalities create a definite economic and psychic hazard. Reduce the fracture as soon as possible. X-ray is not very helpful in most cases. If uncertain as to diagnosis, wait until the swelling has subsided. Examine both the inside and outside of the nose for displacement and movement. The mucosa is anesthetized with cocaine solution 10 per cent and epinephrine 1-2000 on cotton applicators placed upward, backward and laterally and also along the floor of the nose. The external soft parts are injected with 0.5 per cent solution of procaine and epinephrine (10 gtt. to the ox.) along the bases of the nasal processes. Elevate and straighten the nasal septum and return the cartilage to its groove in the vomer. Loosen fragments of the bony arch, elevate and rotate them into position. Any thin strong instrument covered with thin rubber tubing can be used inside the nose. Light vaselined gauze packing and an external splint may be applied. Remove the packing in twenty-four hours.

Fractures of the zygoma usually show depression of the arch of the cheek bone, flatness above and swelling below. Motion of the jaw may be limited. Unilateral nasal hemorrhage, infra-orbital nerve anesthesia and diplopia may be present. Most of these fractures can be reduced by one of the following methods: *through the antrum* (by

an intranasal opening or through the canine fossa); *through the mouth* by an incision above the last upper tooth, inserting an antrum trocar under the zygoma for manipulation and elevation; *by the temporal route* through an incision in the hairline above and in front of the ear, passing a periosteal elevator through the temporal fascia, downward and forward beneath the zygoma. The skull is used as a fulcrum to lever the fragments into place.

Fractures of the maxilla and especially those of the *mandible* usually require some type of permanent fixation after soft tissue wounds have been treated. All completely detached pieces of bone or teeth should be removed but any fragments of bone still attached to the soft tissues should be preserved. It is better to leave a doubtful bone fragment and remove it later if necessary. The co-operation of the dental surgeon will be required for inter- or intra-maxillary wiring if needed. In some cases skeletal reduction and fixation by internal wiring or modification of the Roger-Anderson method may be used. X-ray examination should be made for concealed foreign bodies.

Later reconstruction of bony defects of the face involves some type of camouflage procedure such as grafts of cartilage, bone, dermo-fat, fascia. Peer[2] has recently suggested what he terms, "diced cartilage," for filling these bony defects of the face. The patient's own cartilage is cut into very small cubes and introduced into the defect through an incision below it. The excess is squeezed out and the cartilage patted into the proper contour. Peer states that this type of cartilage graft remains viable, does not change shape and in time becomes quite vascular.

Soft tissue wounds of the face may be treated somewhat differently than wounds of the rest of the body. Because of the better blood supply the tendency to infection is less and the healing more rapid. If the wound is seen within ten or twelve hours and is not grossly dirty, greatly contused or ragged, it may be sutured without

preliminary treatment except irrigation with saline. If first seen after twelve hours, it should be left open, dusted with a sulfonamide powder and saline or bland ointment dressing applied. If the wound is fresh but dirty and can be cleaned with soap and water followed by saline, it may be dusted with sulfonamide powder and closed. Débridement should be less radical in the face than elsewhere. Doubtful flaps even with a small pedicle should be preserved if possible and sutured in place. Attached bone fragments should be preserved and replaced. If hemostasis is doubtful a small rubber strip should be placed between the sutures and removed in twenty-four hours. Small hemostats and fine ligatures must be used. The use of deep sutures is desirable but this will depend upon the judgment and experience of the surgeon. If in doubt they should be omitted. Fine needles and fine suture material are essential and the sutures should not be left in more than three days. At the first sign of infection sutures should be removed and a wet dressing applied. Face wounds like all others should be immobilized as much as possible; talking should be prohibited and feedings done by syringe or tube in the stomach.

The early local treatment of burns under combat conditions will probably be more or less standardized by order. Some type of crust treatment may be used if time permits. The best crust methods are tannic acid, tannic acid and silver nitrate, triple dye, and sulfadiazine in triethanolamine. The crust treatment reduces pain and fluid loss and simplifies the early care of the burned patient. The sulfadiazine-triethanolamine and triple dye crusts form more slowly than the tannic crusts but they are more pliable and infection is less frequent. Crusts should never be used on the face, hands or genitalia. No crust should be left on a third degree burn longer than three weeks. It should then be removed and the defect grafted as soon as all necrotic tissue has disappeared and the granulations are pink, firm and relatively level. The derma-

tome may be used to cut large grafts which are sutured in place and fixed with elastic pressure (sponges or cotton waste). The safest graft to use, if one is not experienced, is the small deep graft of Davis. These grafts are small pieces of skin, full thickness in the center and thin at the edges. They are picked up on a needle held in a clamp and cut as described by Davis[3] with a knife or razor blade held in a clamp. They may be placed as close together as desired. These grafts should never be applied to exposed parts such as the hands or face. Whichever type of graft is used on a granulating surface, the first dressing should be done on the third day and the elastic pressure continued for a week to ten days. Other methods of treatment are the envelope method favored by the British,[4] the pressure method[5] and the saline bath method.[6] The envelope treatment employs an oiled silk sleeve with an inlet and outlet which fits snugly to an extremity. Electrolytic sodium hypochorite flows slowly through the sleeve. Saline or a sulfa solution may be used instead of the sodium hypochlorite. The pressure method uses sulfonamide powder covered with vaseline gauze, cotton waste and a cast or elastic pressure bandage. Burns of the face may be sprayed with a fine sulfonamide powder and covered with one layer of vaselined gauze and a saline pack. The saline bath method requires more nursing care than is available under wartime conditions.

The *treatment of the contracted scars*, which so often follow severe burns, presents a major plastic problem. The degree of contracture is directly proportional to the healing time. The longer the time required for healing, the thicker the scar, and the thicker the scar the greater the contracture will be. Thick scar webs on the neck and face and across joints of the extremities are not only unsightly but interfere greatly with function. Thick burn scars may continue to contract for weeks or months after surface healing is complete. This tendency varies greatly in different individuals even to the point of true keloid formation.

Plastic reconstruction should be delayed until the scars have become relatively soft and most of the redness has faded. Four to ten months may be required to reach this stage. Flaps of scar tissue can then be shifted within reasonable limits so that tension is removed and function restored, frequently without the necessity of grafting or moving flaps from a distance. One of the best ways of doing this is by transposing the points of a z-shaped incision.[7] Whatever method of shifting flaps is used the new suture line should run at angles to the former scar band. Contractures relieved by shifting flaps do not recur if the blood supply of the flaps has been accurately appraised and they remain completely viable. When grafts are used instead of flaps some degree of contraction of the grafts follows and relief of the contracture is not complete. However, if complete relaxation cannot be obtained by shifting flaps, the remaining defect must be covered with a graft.

What has just been said concerning the shifting of flaps instead of applying grafts emphasizes one of the first principles of plastic surgery. This principle is that all available adjacent tissue should be utilized in the correction of a defect before bringing in tissue from a distance. With the advent of new methods and new instruments there is a tendency to forget that established surgical principles remain unchanged. The Dermatome, invented by Earl Padgett, has made the cutting of large skin grafts of predetermined thickness a relatively simple matter. This instrument, properly used, represents a real technical advance in skin grafting and if the principle mentioned above is followed, it will not be misused.

The scope of this paper does not permit detailed discussion of types of grafts and flaps which will be needed in the reconstruction of the defects produced by modern instruments of warfare. Skin grafts vary as to thickness and size. The full thickness graft is cut according to a pattern of the defect to be covered. It is carefully dissected so that no fat remains on its

undersurface, sutured accurately into its new site and dressed under elastic pressure for over two weeks. This graft requires a firm, sterile bed. It can be used only on a fresh, surgical wound and in an area which can be completely immobilized. Its "take" is less certain than a part thickness graft, cut with knife or Dermatome, but if it takes completely gives a good functional and cosmetic result. Part thickness or split grafts take more readily, and if cut through the deeper layers of the skin yield almost as good a result. They have the added advantage of leaving enough skin elements for regeneration of the donor site. The usefulness of the small deep graft of Davis in grafting large, deep burns when the condition of the patient is poor has been mentioned.

Flaps differ from grafts in that they include both skin and fat and depend for survival on an intact blood supply. One end of a flap must remain attached and carry the blood supply while the other end is growing into its new site. After two to three weeks the second end has acquired a new blood supply; then the first end may be detached and the rest of the flap fitted into its new location. Flaps may be brought from a distant part of the body by rolling them into a tube and grafting one end temporarily into a movable part, usually the hand or wrist. Flaps are useful in correcting defects of contour and for covering exposed tendons and other deep structures but they require multiple operations and long hospitalization while grafts usually need but one operation. Flaps retain their original color fairly well but grafts are prone to show increased pigmentation at times. Flaps contract scarcely any after they are fitted to their new site but grafts may show over 50 per cent contraction if cut through the outer quarter of the skin. All grafts contract somewhat but the thicker the graft the less the contracture. It should be remembered that a graft is always a "patch," and seldom matches the surrounding skin perfectly. A rotated or shifted flap of normal adjacent tissue is

always more satisfactory if available. Rather extensive scars may be removed by repeated, partial excisions. At times it is desirable to apply a temporary graft then later excise the graft in stages, with long intervals between them. It should be emphasized that grafts are a rather poor substitute for the original skin but they should be used without hesitation when indicated.

An opportunity is sometimes missed because the surgeon does not think of the possibility of immediate grafting of a traumatic wound with loss of tissue. This may be important in getting a war casualty back into service quickly. If the wound is seen within six hours of the injury and is grossly clean or can be débrided satisfactorily, and the defect cannot be closed in a reasonable manner, immediate grafting should be considered. A graft of any desired thickness or length and up to one and three quarters of an inch in width can be cut with an ordinary safety razor blade held in a clamp. The graft is tacked at several points with interrupted sutures, trimmed to fit, and a running suture of "c" silk carried around the edge. Several small holes should be made in the graft for drainage of serum. The graft is then covered with one layer of vaselined gauze and one thickness of saline gauze sponge. Over this is placed a rubber sponge, synthetic sponge, sea sponge or cotton waste and firmly bandaged. The first dressing is done on the fifth day or earlier if an odor or other sign of infection is observed. Elastic pressure is continued for ten days to three weeks depending upon the thickness and condition of the graft. When the back of a hand is denuded, exposing tendons, the hand may be placed under an abdominal flap through two parallel incisions. When the skin and fat pad of a finger tip is lost the defect may be attached to a flap raised on the proximal part of the palm or to a similar flap on the abdomen. The subsequent care of these flaps follows the principles of flaps elsewhere.

SUMMARY

1. The war casualty should receive the benefit of modern methods of reconstruction. The preliminary treatment of the casualty may determine to a large extent the outcome of later reconstruction.

2. Facilities for postgraduate training in plastic surgery should be augmented to meet the demand for surgeons properly trained in this specialty.

3. Conservation of tissue is important in care of wounds and compound fractures of the face.

4. Early skin grafting is essential in the treatment of large deep burns. When possible a method of early local treatment should be used which will facilitate early grafting.

5. Contracted scars should be relaxed by shifting flaps and skin grafts used only as an alternative.

6. Immediate grafting of certain wounds should be considered as a means of preventing deformity and shortening the period of disability.

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HYDROCALYX*

ITS RELIEF BY RETROGRADE DILATATION

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THE treatment of hydrocalyx has always been either by nephrostomy with dilatation of the isthmic stricture or by calycealectomy. In some cases nephrectomy is performed. In any event an open operation is done. The case presented here is one in which a catheter penetrated an infundibular stricture, entered the hydrocalyx and allowed free drainage thereafter with complete relief from symptoms to the patient. This was inadvertently done during the course of a routine retrograde pyelography wherein catheters were passed into the renal pelves. Such a case has not been found in urological literature.

Dilatation of a single renal calyx not attended by concommitant dilatation of other calyces in the same kidney is due to obstruction or stricture of the isthmus between the calyx and the pelvis. The isthmic portion is usually designated as the infundibulum of the calyx and such a dilated calyx is referred to as a hydrocalyx or hydrocalycosis of the kidney. This is to be distinguished from the state of dilated calyces occurring in pyelonephritis which is referred to as "clubbing" of the calyces and is not due to obstruction but to adynamic factors in the calyces (Braasch and Doss). Infundibular constriction may be due to localized infection with consequent stricture of a portion of the pelvis causing calyceal stasis and the formation of calculi in a great many cases.

CASE REPORT

M. B., a twenty-nine year old male, was first seen in April, 1941, complaining of persistent dull ache in the right loin with occasional attacks of sharp pain. This symptom was persistent during the past year and the paroxysms of sharp pain had increased in frequency in the past two weeks. Physical examination revealed a well nourished but slightly built male of twenty-nine years having definite tenderness on firm palpation over the righ renal area. He had always enjoyed good health in the past. There were no other relevant findings; his urine was clear and he was sent in with a provisional diagnosis of right renal stone. A No. 24 Brown-Buerger cystoscope was passed into the bladder with ease. The bladder mucosa was normal in all respects and there were no foreign bodies or signs of inflammation. A No. 6f opaque catheter was inserted into each ureteral orifice and passed up into each pelvis without difficulty. Specimens were collected for urea, microscopic examination and culture; phenolsulfonphthalein appearance time was three minutes from each side. Specimens were collected for percentage determination. A flat plate with the catheters in place revealed no evidence of opaque shadows. The kidneys were of normal size and the psoas muscle outlines were fairly clear. Six cc. of 20 per cent diodrast was then injected into the left pelvis before the patient felt some pain and not until 20 cc. of diodrast was passed into the right pelvis did the patient experience pain on that side. A pyelogram was taken and this showed a large dilatation of the superior calyx of the right kidney with a definite stricture of the infundibulum of that calyx. The rest of the right kidney as well as all of the left kidney showed no abnormality. Urea and phenolsulfonphthalein excretion determinations were normal. Cultures showed no growths and microscopic examination was essentially negative. The right catheter had penetrated the stricture and entered the calyx thereby offering free drainage. (Fig. 1.)

The patient was told to return a week later. At that time he stated that all the pain in his right loin was gone and that he was free of all

October 26, 1942, which was nine months after he was first seen, pye'ograms of the right side were again made. (Figs. 3 and 4.)

FIG. 1. Routine pyelogram taken when patient was first seen. Catheter is shown penetrating infundibular stricture of superior calyx of right kidney and entering hydrocalyx.

FIG. 2. Right pyelogram taken seven months later. Catheter is used to dilate isthmic stricture. Hydrocalyx slightly smaller than when first seen.

symptoms. He was cystoscoped again and a No. 7F bougie was passed into the right pelvis. Thereafter he was told to return every three weeks and on each occasion the isthmus of the calyx was dilated. The patient consented to these treatments under some protest, stating that he felt perfectly well, had no symptoms whatever and could see no reason why he should be required to return for further treatments.

A right pyelogram taken seven months after he was first seen showed a moderate diminution in size of the dilated calyx, a lengthened infundibulum of that side with the catheter occupying the isthmus and entering the calyx. (Fig. 2.) The patient was still symptom free and dilatation of the isthmus with Nos. F7, 8 and 9 catheters every three weeks was continued until January, 1942. He was given a rest period of nine months during which time he had experienced none of his previous pain and enjoyed good health. On

This time several x-ray exposures were made before it was ascertained that the catheter had entered the hydrocalyx. It was necessary to change his position slightly in order to try to get the catheter to enter the superior calyx. Figure 3 shows the unusual course the catheter followed before entering the infundibulum. In Figure 4 the dilated calyx is well outlined and, by comparing with Figure 2, it appears that the calyx is slightly smaller in size and much smaller than in Figure 1 when the patient was first seen. Cultures of the right kidney showed no growth and function according to phenolsulfonphthalein determination was normal as was the urea elimination. No pus cells were seen in the catheterized specimen. There were no other abnormalities. This patient has never shown any evidence of infection of the upper urinary tract at any time.

There were times during the course of these dilatations when the catheter would not enter

the superior calyx. In that case it was necessary to manipulate the catheter by twisting or by changing the position of the patient by having

In reviewing the literature the age incidence of hydrocalyx occurs in the third decade of life with almost constant regu-

Fig. 3. Plain plate taken eighteen months after admission showing unusual coarse catheter followed before it entered superior calyx.

Fig. 4. Pyelogram of Figure 3 showing catheter in hydrocalyx which is considerably smaller than when first seen in Figure 1.

him rotate to right or left before we could see the catheter pointing in the direction of the superior calyx. A stylet was never used to splint the catheter as the danger of such a maneuver is apparent. Not infrequently during the course of routine retrograde pyelography we see the catheter enter the superior calyx.

Although this is a study of one case it points out three definite facts: (1) There is definite pain in a distended calyx in which there is no stone. (2) In some instances it is possible to relieve the patient by retrograde dilatation without the necessity of open operation. (3) An infundibular stricture of the superior calyx is the most accessible one for this type of treatment.

At the time of the preparation of this paper, twenty-two months after the patient was first seen, he is still free of all symptoms.

larity. Braasch reported a case of a twenty-seven year old male with infundibular stricture and dilated calyx without stone. The patient was relieved of all symptoms after free drainage of the hydrocalyx by a nephrostomy and dilatation of the stricture were done. Braasch believed that a calycealectomy was not necessary.

Prather reported three cases of calyceal diverticula all in adults in their third decade of life. In each case a nephrostomy was done. Only one of these cases did not show the presence of a stone. Prather's treatment of these patients consisted of nephrostomy, dilatation of the infundibular stricture with a Kelly clamp and an attempt at approximation of the calyceal walls with nephrostomy sutures. Pyelograms taken a year later in one of his cases

showed that the walls did not remain approximated and that the diverticulum had diminished in size and was not retentive. The patient was symptom-free.

stricture of the infundibulum in a twenty-one year old female whose urine was clear at all times. She was relieved of all symptoms by open operation. Braasch, too,
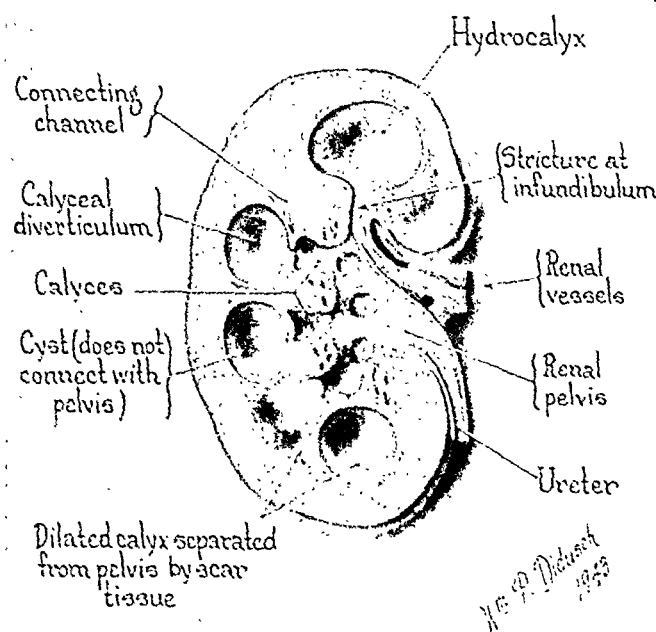
Fig. 5. Composite illustration showing the differences between hydrocalyx, calyceal diverticulum, cyst of the kidney and obliteration of calyx following pyelonephritis.

Hyams and Kenyon reported four cases of dilated calyces of a different nature. In their cases the patients had all recently recovered from an acute attack of pyelonephritis which was followed by stricture formation of the infundibula. This condition was described as "localized obliterating pyelonephritis."

The distinction between hydrocalyx, calyceal diverticulum, renal cyst and localized obliterating pyelonephritis may be summed up briefly in the following four paragraphs.

Hydrocalyx. Dilatation of a single calyx due to obstruction may be defined as hydrocalyx (Watkins). He also states that when there is no apparent obstruction the cause may be due to achalasia at the neck of the calyx or at its junction with the renal pelvis (ring muscle of Disse). G. G. Smith stresses the rarity of dilatation of a single calyx which is not due to ulceration or stone formation. He reports a marked

stresses the rarity of infundibular stricture and doubts that the constriction is ever congenital. He calls attention to the fact that retention and blockage due to constriction may only be temporary and hence may be demonstrated only at the time of pain. Hyams states that the initial reduction in caliber of the infundibulum seen in hydrocalyx seems to remain static if there is no infection. He recalls one of his cases in which there had been no diminution in size of the lumen during a six-year period of observation.

Calyceal Diverticulum. This is not to be confused with hydrocalyx. A calyceal diverticulum is a dilated cavity distal to and not part of the calyx but is connected to the calyx by a small channel. This was very well brought out by Prather in his recent paper. He reported three such cases, all in the third decade of life.

Renal Cyst. Cysts situated adjacent to the renal pelvis will sometimes rupture into

the pelvis with secondary infection and cause acute symptoms. Here it may be difficult to differentiate such cysts from a dilated calyx or calinephrosis caused by obstruction or constriction of the infundibulum (Braasch). Ridlon showed a cortical cyst of the kidney communicating with a calyx through a pin-point opening. Its pyelographic appearance was very much like that of a calyceal diverticulum. Repeated ineffectual emptying of an enlarged calyx causes increasing dilatation and destruction of the overlying renal tissue. In the final stage the communication with the pelvis becomes obliterated and what was once a hydrocalyx has now become a true cyst (Kenneth Watkins).

Localized Obliterating Pyelonephritis. During the course of pyelonephritis the infundibular portions of the calyces are sometimes the seat of a marked inflammatory process. This process may go on to terminate in stricture formation with either complete destruction and disappearance of the involved calyx or to isolation of the calyx from the pelvis by an impenetrable stricture. This process has been called "localized obliterating pyelonephritis" by Hyams and Kenyon. The clinical differentiation of this process from cysts located near the renal pelvis is made by the previous history, urinary findings and the course of the disease.

CONCLUSIONS

A case of uninfected hydrocalyx without stone which was relieved by retrograde dilatation is presented. Three salient points are brought out: (1) Hydrocalyx of the superior calyx can be relieved in some instances by retrograde dilatation with consequent free drainage. (2) There may be definite pain in a distended calyx in which there is no stone. (3) Open operation is not always necessary.

A review of the literature and differential diagnosis is made of hydrocalyx, calyceal diverticulum, renal cyst communicating with the pelvis, and localized obliterating pyelonephritis.

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MANAGEMENT OF ACUTE SUPPURATIVE APPENDICITIS IN THE SMALL RURAL HOSPITAL*

A REPORT OF ONE HUNDRED CONSECUTIVE CASES

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DEATH should have a sobering effect on the medical attendant as well as on the family of the deceased. Medical or surgical deaths should be looked upon as unsolved problems. Two deaths from acute suppurative appendicitis on my service, occurring within a period of four months, provided the stimulus for the study which culminated in the writing of this paper. These deaths occurred in 1939 and in the following two years, included in this study, thirty-five cases have been treated without a death.

Heyd[1] has said, "Within very definite imits, there should be no deaths from appendicitis." He goes on to say, "The presence of pus, gangrene or general peritonitis at the time a patient is operated upon for appendicitis, is in a large measure proof that the case has been neglected or delayed."

Appendicitis, which causes over 16,000 deaths annually in the United States, presents a problem worthy of the united efforts of the medical profession and intelligent laymen, but for some reason this problem seems to lack the appeal that goes with the fight against cancer, tuberculosis, syphilis, heart disease, etc. Little difficulty is encountered in establishing foundations and endowing fellowships for the study and control of these diseases, yet year after year an inexcusable mortality is chalked up against appendicitis, when a little flag waving and drum beating in that direction might save thousands of lives. It is true that the mortality from these other diseases is higher than that from appendicitis, but is it not also true that the deaths from these are more likely to occur among older

and do I dare add less valuable citizens? In the series of cases to be discussed in this paper 70 per cent of the attacks were in patients under thirty years of age and 80 per cent were in patients under forty years of age. More than half of the attacks were in the second and third decades of life when the average individual is just entering the most promising part of his career. The attack on appendicitis, from the public health standpoint, has lacked the attention that it deserves; yet the efforts that have been invested in it have paid large dividends in human lives. A glance at the experience in Philadelphia, where several organizations, including the County Medical Society and the Association of Retail Druggists co-operated in placing posters in drug stores urging patrons to see a physician and not take a laxative when afflicted with abdominal pain, shows what can be accomplished. The mortality from appendicitis in Philadelphia has been reduced almost 60 per cent since 1928, when this educational program was instituted. The same program, if made country-wide might save 10,000 lives annually. We offer no objection to the warning, "Don't spit on the sidewalk," when it is plastered up in the most conspicuous places. I do not believe it would be any more abhorrent to see displayed in public places the admonition, "Don't take a physick when you have a pain in the belly." It would at least provoke discussion.

Sufficient thought has not been given to the problems peculiar to medical and surgical practice in rural communities. A conference on rural medical practice was held at the Mary Imogene Bassett Hos-

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pital at Cooperstown, New York, several years ago, where some of the problems of the rural practioner were discussed. Simons[2] has published a study of pneumonia in a town of 435 inhabitants, making a comparison between the results of treatment in rural and city practice. Other studies on the care of certain diseases, away from the thickly populated districts, have been published, but a preponderance of medical literature, even that concerning rural health problems emanates from large urban centers and the papers are usually written by observers who have little if any contact with rural medicine. The opportunity for observation of patients in greater numbers and the stimulating effect of contacts with the teaching centers make this inevitable. However, there is a real challenge to the rural physician or surgeon to study the problems of disease as they affect his particular domain of practice.

The pathological processes which go on in the wall of the vermiform appendix are the same whether they take place in the metropolis or the smallest village, but the problem of halting these processes before they endanger life may differ in the country and in the city. The mortality from appendicitis is said to be higher in the country than in the city. There may be reasons for this for which the rural surgeon is not to blame. The cases which I have used as a basis for this paper were all treated in the rural hospital and any·conclusions which may be drawn from them will bear directly on the problem as we see it in rural and small town practice.

Before launching into a maelstrom of statistics, I would like to pause for a moment to do the "little assassin" as Deaver was wont to call the vermiform appendix, the honor of briefly reviewing its history. Royster,[3] in his monograph on "Appendicitis," says that the appendix was recognized anatomically in the sixteenth century, pathologically in the eighteenth century, but that clinically it is a product of the ninteteenth century. It is true that Saraceous, in a letter dated

August 28, 1642, described an abscess in the right iliac fossa, with discharge of fecal material and that this was undoubtedly from a perforated appendix, but the credit for the first reported case is usually given to Mistivier, who in 1759 drained a pint of pus from the right iliac fossa and at autopsy found a large rusty pin in the vermiform appendix. The literature is replete with interesting episodes reported by early observers, all of which helped lay the foundation for the surgical attack which was to follow. As in all problems in surgery, the answer was not found until the pathological process was understood. The early workers considered that the disease began in the cecum and spread to the appendix. Kelly and Hurdon[4] state that Volz, in 1843, concluded that the appendix was at fault in affections of the right iliac fossa, more than was the cecum. The first operations were simple drainage and some modern surgeons or pseudosurgeons might take a lesson from this and restrict their activities to simple drainage until they have mastered the technic of removing the organ from the midst of coils of plastered intestine without breaking down nature's wall of protection. Simple drainage remains the procedure of choice in large appendiceal abscesses, in which the appendix is not easily accessible and its removal would result in contamination of the general peritoneal cavity.

Who first removed the appendix at operation, I do not know, but it is true that to American medical men goes the credit for the rapid advances in treatment of inflammation of the appendix made during the latter part of the nineteenth century. Reginald H. Fitz,[5] of Boston, read his paper on "Perforating Inflammation of the Vermiform Appendix" before the Association of American Physicians in 1886. He described the different results of perforation of the appendix, namely, general peritonitis and appendiceal abscess. He warned of the dangers if not treated and advocated early operation. Following publication of Fitz's paper in the American

Journal of the Medical Sciences, operations for the removal of the appendix became more and more frequent and were done with more confidence. McBurney[6] read a paper before the Medical Society of the State of New York in 1891, in which he reported twenty-four early operations in serious cases with only one death. Deaver states that the work of McBurney, Richardson, Murphy, Price, Fowler, Morris and others has added greatly to our knowledge of the subject and aided physician and surgeon in coping with the disease in a satisfactory and life saving manner. Deaver's own name must be added to those who by example and precept have established the fact that appendicitis is a disease with only one treatment and that surgical. It is fitting that the names of these men should be perpetuated through the names of instruments and technics in appendiceal surgery. If we are confronted with a case of appendiceal abscess we will probably open the abdomen through a McBurney incision, retract the margins of the wound with Richardson retractors, later use Deaver retractors after the placing of packing sponges, insert Morris drains and after the patient returns to bed place him in the Fowler position. If he is unfortunate enough to develop a fecal fistula which is resistant to closure, we may resect a section of the bowel and if there is reason for shortening the operative procedure, anastomose it with a Murphy button.

The management of the acutely inflamed appendix involves two equally important factors, diagnosis and treatment. Success in this management is more likely to be achieved if both are early. Obviously, early treatment is dependent upon early diagnosis. The responsibility for early diagnosis lies more often than not with the medical man rather than the surgeon. Frequently, the surgeon has no opportunity to share the responsibility unless he is invited. All too often the physician thinks of the surgeon as a technician to be called upon only if an operation is to be done; yet he himself has either never developed the ability for or has lost his interest in the careful and painstaking diagnosis of appendicitis. This places the patient in a not altogether enviable position. Reginald Fitz,[7] himself an internist, and a son of the man who read the paper on appendicitis before the Association of American Physicians, comments on the lack of interest in appendicitis among physicians, in a paper entitled, "The Challenge of Appendicitis," published in 1939. He states that in the past fifty years only six papers on appendicitis have been read before the Association of American Physicians, while in the same period about ten times that many have been presented before the American Surgical Association. Alvarez's,[8] "An Introduction to Gastroenterology" has gone through three editions. This beautifully written discussion of the mechanics of the digestive tract in health and disease is among my most prized possessions and yet I am astounded when I note that he dismisses appendicitis with a few short paragraphs. In these he describes the case of a young woman who had a ruptured appendix and did not vomit. He infers that this is a most unusual circumstance. Six such cases are included in the small group analyzed in this paper.

The basis for the remainder of this paper is a series of one hundred consecutive cases of acute suppurative appendicitis treated on my service and upon which I have operated in the ten years since I entered private practice. From about 160 charts of cases diagnosed preoperatively as acute appendicitis I have eliminated all those in which the pathologist's diagnosis or the gross appearance did not justify the final classification as acute suppurative appendicitis, including of course the cases which had reached the more advanced stages, such as gangrene or perforation. The great majority of these patients were operated upon in a thirty-five-bed hospital in a town of 5,000 inhabitants and the pathological diagnoses were made at the

Memorial Hospital in New York City. The remaining patients were operated upon in a fifty-bed hospital in a neighboring town of 5,000 and the pathological diagnoses made by the hospital pathologist. The patients were referred mostly by general practioners in the two communities and came from the two towns, the surrounding farms and from summer colonies at several resort lakes. All cases of acute catarrhal appendicitis and those diagnosed by the pathologist as simple acute appendicitis, subacute appendicitis and chronic appendicitis have been omitted. There were no deaths among these, so they might be used to lower the mortality rate in a study of all patients operated upon. One hundred cases of acute appendicitis with pus or gangrene remain for our consideration. Twenty-five of these had perforated with a resulting peritonitis of greater or lesser degree. The data from these charts were tabulated and will be discussed under the general headings of diagnosis, prognosis and treatment.

DIAGNOSIS

Muller taught at the University of Pennsylvania that the symptoms of acute appendicitis in the order of their appearance were: pain, tenderness, rigidity, vomiting, rapid pulse, fever and leucocytosis.

Pain was present in all of the one hundred cases and was the only constant symptom. It was described as follows in the histories:

	No. of Cases
Slight	35
Moderate	41
Severe	24

The locality of the pain varied, but the two most characteristic locations were around or above the umbilicus and shifting to the right lower quadrant or beginning originally in the right lower quadrant.

Tenderness was present in ninety-eight of the cases and I consider it a more important symptom on which to make the diagnosis than pain. I refer of course to tenderness in the right lower quadrant. The point of maximum tenderness was usually, although not invariably at McBurney's point, which lies on a line between the anterior superior spine of the right ilium and the umbilicus and about one and one-half to two inches from the ilium, depending upon the size of the patient. In this series of cases the tenderness was qualified as follows:

	No. of Cases
Absent	2
Slight	19
Moderate	31
Extreme	48

Tenderness is best elicited by exerting gentle pressure at first and it is well to begin this pressure at some other point than McBurney's, even on the left side. If there is real tenderness, the patient will usually mention it without any questioning or it can be detected by facial or abdominal reactions or a flexed right thigh. These observations bear more weight than verbal answers for it is a very stoical individual who can mask the pain when pressure is made at McBurney's point over an acutely inflamed appendix. A verbal declaration of tenderness coming from a grinning face usually fails to elicit much sympathy from me when unaccompanied by some other physical confirmation. It is not good for one's reputation to operate for ticklishness.

Rigidity was a close third, being present in ninety-two cases. This may be a difficult sign to evaluate, but it is worthy of careful consideration. It is so dependent upon the position of the inflamed organ that it is subject to wide variations. Do not expect it to be extreme, but take its presence seriously in any degree. These records showed it to exist in the following degrees:

	No. of Cases
Absent	8
Slight	41
Moderate	32
Extreme	19

These are the three cardinal symptoms of appendicitis, pain, tenderness and rigid-

ity. Look for the others, but make your diagnosis on these. You will seldom be wrong.

Fifty-seven of these patients *vomited*. In addition, nineteen others were nauseated, making a total of seventy-six who were "sick at the stomach." This is a symptom which cannot be neglected and when associated with abdominal pain is of major significance.

Rapid Pulse. I took 75 as the normal and seventy-nine of these patients had pulse rates above this. *Fever* was present in eighty-five. These are seen to be frequent signs, but do not expect them to be marked, especially the fever. If it is high, consider carefully the other abdominal conditions and look outside the abdomen. You may be rewarded with the opportunity to make a brilliant diagnosis.

Blood counts were done in ninety-five of these cases and ninety of them had *leucocytosis*, considering 10,000 white blood cells as the upper limit of normal. Only ten of the ninety-five were below 12,000. The five patients with normal white blood counts were all males and four of them were past fifty years of age. Three of these four had elevated polymorphonuclear counts. Differential counts were done in seventy-three of the cases, sixty-nine having polymorphonuclear counts above 70 per cent; *fifty-six or more than half had polymorphonuclear counts above 80 per cent, and fourteen above 90 per cent.* The total white blood counts were very high in both patients who died. The polymorphonuclear count was high in one and not done in the other.

To Muller's classification of symptoms I have added diarrhea and constipation, for I was curious about these. Fourteen had diarrhea and fifteen were constipated, either chronically or prior to the attack. Do not be led astray by the presence of diarrhea; look for a pelvic appendix.

Pelvic or rectal examinations were recorded in only forty-two of these cases. The findings were positive for a mass or right pelvic tenderness in thirty-three or

75 per cent; fourteen of these were females. Pelvix tenderness in a female patient does not always mean salpingitis. If it is present on the right side, go back and review the other signs and symptoms, before referring the patient to the gynecologist. Extreme tenderness may be found on pelvic or rectal examination when the tenderness at McBurney's point is negligible. It may be the deciding factor between operation or non-interference in a very acute case of appendicitis. Pelvic or rectal examination should be done routinely or at least when the other findings are not convincing. Appendicitis is no exception to the rule that a sick person deserves a complete examination.

PROGNOSIS

The time of onset is of great importance. In the opinion of many, it should radically influence the treatment. This is debatable, but all agree that it definitely alters the prognosis. In the two deaths in this series, the onset preceded operation by forty-eight hours or more. Larger series of statistics invariably show that delay increases the mortality. The necessity for drainage is one criterion of the seriousness of the case as seen at operation. Following is a grouping of these cases with regard to time of operation and whether or not, in the opinion of the operator, drainage was indicated:

Time of Operation Following Onset	Number	Drained, Number	Per Cent
Under 24 hours	31	7	22.9
24 to 48 hours	45	21	46.6
Over 48 hours	24	24	100.0

The taking of laxatives at the time of or following onset influences the prognosis. Deaver used to teach that purgation and perforation were almost synonymous. He enjoyed quoting the following verse:

"Purgation means perforation
In an appendix kinked and bad.
Food and drink worry him,
And aperients drive him mad."

Twenty-two of this series are known to have had laxatives. Six of these had demonstrable abscesses or peritonitis. In eight others the appendix was gangrenous or necrotic. Probably some of the others who had perforated appendices had taken laxatives, but did not admit it, when the history was taken. One young woman apologized for it, but said her mother had urged her to take the laxative.

TREATMENT

There is only one treatment—*operation*. The optimum time for this, in certain cases, is still being debated by eminent authorities. Any patient with acute appendicitis admitted to a hospital and not operated upon, should probably be classified in the final filing as untreated. With the exception of three cases, all the patients in this series were operated upon without delay. Operation was delayed in two of these because of an uncertain diagnosis and in one because the patient refused it for three days. Her obstinacy was rewarded with an appendiceal abscess and a prolonged hospital stay.

The question of anesthesia is one of importance. In the small rural hospital its choice may depend upon factors that do not come up for consideration in the large and completely staffed institution. In this series spinal anesthesia was used in seventeen cases, general in thirty-three and avertin with general in fifty. If operation must be done without the services of a physician versed in anesthesia or a competent nurse anesthetist and the surgeon has had training and experience in the use of spinal anesthesia, I believe that form is the method of choice. It should not be used, however, without careful observation of the patient during operation, either by a physician or a dependable nurse who will report immediately any change in the patient's condition. The various means of combating the rare untoward symptoms resulting from spinal anesthesia should be available and the surgeon should be acquainted with their use. The anesthesia

of my choice, for most appendiceal surgery, is avertin, with a maximum of 70 mg. per kilo of body weight, supplemented with nitrous oxide and oxygen. In the very sick and toxic cases I sometimes prefer open drop ether. I agree, however, with the advocates of spinal anesthesia that it simplifies the operative technic. It has definite indications in selected cases and under certain circumstances. The surgeon contemplating rural practice should make a very special point of acquainting himself with the use of spinal anesthesia. Sooner or later he will find himself in a situation in which it is by far the best and safest method.

The approach to the appendix is usually through a right rectus, muscle retracting incision or a gridiron, muscle splitting incision. The former is usually referred to as the Kammerer and the latter as the McBurney, although first described by McArthur. The right rectus incision may be varied by retracting the muscle laterally, rather than medially, as Kammerer did, or by splitting the fibers. In this series of cases the McBurney incision was used seventy-eight times, the right rectus twenty-one times and the transverse incision of Davis once. The use of the right rectus incision was mostly in the first few years of the period covered by this study. I became more and more convinced, that especially when operating with only one assistant, as we usually do in the small hospital, the McBurney incision reduced the technical difficulties to a minimum. It has many advantages which are obvious to those who have given it an adequate trial. It is quicker, easier, more direct, safer, provides a better channel for drainage and due to its not destroying blood or nerve supply, it is less likely to result in postoperative hernia. The opponents of this incision, who all too often have not tried it, argue that it is not satisfactory for exploration. We are operating for acute appendicitis, when we use this incision, not to palpate the spleen. Lahey,[9] who is not an opponent of the muscle splitting

incision of McBurney, but who prefers the right rectus approach, states, "In the surgical management of acute appendicitis we are concerned with a low mortality rate, with not spreading the infection, with visualization of the acutely inflamed appendix and its removal, and with as little manipulation of the surrounding coils of intestine as possible, and to do this it is essential to have an incision of adequate length to permit wide exposure." To this I would add that the incision must be anatomically placed and we have a convincing case for the McBurney incision. If we adhere to sound surgical principles, we try to prevent contamination of any part of the peritoneal cavity beyond the right iliac fossa. This may be difficult when the approach is across the coils of the small intestine, which are likely to present themselves in the right rectus incision. If we have erred in our diagnosis and want to explore, this can be done, within limits, through the McBurney incision, especially with the use of the Weir extension, which involves incising the rectus sheath and retracting the rectus muscle medially. On a rare occasion when the diagnosis is so far off as to require extensive procedures in distant parts of the abdomen, the McBurney incision may be quickly closed and another incision made over the site of the pathological process. In such cases the low right rectus incision may very likely have proved inadequate also.

A certain female patient died from peritonitis following an appendectomy through a right rectus incision in a prominent New York hospital. It was the incision taught on the service where the surgeon was trained. A member of a rival service remarked that if she had had a McBurney incision she would not have died. That would be difficult to prove, but Mont Reid,[10] in 1934, reported a 50 per cent decrease in the mortality from acute appendicitis in the Cincinnati General Hospital after the adoption of the McBurney incision in place of the right rectus. All I ask is that the proponents of the right rectus incision try the McBurney in ten consecutive cases of acute appendicitis.

Another matter of technic of special interest to the surgeon dealing with appendicitis is the treatment of the stump. I prefer to remove the appendix with the actual cautery, thoroughly cauterizing the stump, but I have no argument with those who prefer the phenol and alcohol treatment. The modern cautery, with boilable cord, handle and tip, make the use of the cumbersome draping of the cautery handle, with its attendant opportunities for contamination, unnecessary. After treatment of the ligated stump, it may be dropped back into the iliac fossa or buried with a previously inserted purse-string suture. It is incorrect to refer to this as inverting the stump, if the base of the appendix has been securely tied, prior to the removal of the organ. It is rather burying the stump in a pocket created in the wall of the cecal head. True inversion, as described by Ochsner and Lilly,[11] is the burying of the crushed, but unligated stump, so that the edges of the small collar of the appendix which remains will actually invert into the lumen of the bowel. They present a very good brief for this technic and I am convinced that carefully done it is the safest and most rational method of dealing with the stump. However, it is not a method to be tried with the casual or occasional assistant and this is the type of assistant we may have in the rural hospital. If he allows the base to escape from the grasp of his forceps, the field may be soiled with intestinal contents.

A happy medium between the secure ligature of the base and true inversion is the use of a single knot, plain gut ligature, cut close, before inversion. Any amount of purulent material which forms in the wall of the cecum, will by its own pressure untie the single knot and empty itself harmlessly into the lumen of the bowel. I devised this technique after reading the paper by Ochsner and Lilly and have used it with a feeling of security since then.

Jones[12] described a similar technic in 1940. He modified the method of Lenander, as described by Kelly and Hurdon,[4] in which a temporary loop of suture material was placed around the base of the appendix, but removed before inversion of the stump. Jones grasps both strands of the loop ligature with the tip of a fine hemostat, close to the appendix. He inserts the purse-string suture, removes the appendix, which is clamped just distal to the loop and treats the stump with carbolic acid and alcohol. He then cuts the two ends of the loop ligature flush with the end of the hemostat and inverts the stump through the purse-string suture. He then releases the hemostat and tightens the purse string. Following this he reinforces the area with a silk mattress suture and presses the buried stump between the thumb and forefinger to open it and reinforces the suture line by suturing the stump of the meso-appendix over it.

The question of drainage following the removal of the perforated or gangrenous appendix is one that requires considerable surgical judgment. Fifty-three of these wounds were drained; twenty-five of the patients having drains had ruptured appendices. Discussion of the criteria for drainage in a paper of this kind, would be almost useless, for each individual case must be considered on its own merits. It might be well, however, to make the bold statement, "When in doubt, don't drain." This is contrary to the teaching of fifteen or even ten years ago, but is in accordance with the best surgical thought of today. This is especially true since the introduction of the sulfa drugs. Since the majority of these patients were operated upon before the widespread use of sulfa drugs in the peritoneal cavity, these aids were not used in many. However, in the later cases, sulfanilamide was introduced intraperitoneally in some and into the layers of the wound when wound contamination was feared. Sulfathiazole was reserved for systemic treatment, either orally or parenterally.

It would be missing an opportunity in the discussion of the technic of the operation for appendicitis, not to stress the need for extreme care and attention to details. Speed is of little consequence. The time for speed is in making the diagnosis and getting the patient to the operating table. I believe in trying to eliminate lost motion, but most motions may well be made deliberately and with extreme care. It is both discouraging and disgusting, when one has freed an adherent and gangrenous appendix with no soiling, to have the assistant wipe it across the edge of a fat wound margin, thus inviting a wound abscess. It will pay to have taken time to protect the wound edges with gauze and to have instructed the assistant as to what you expect of him.

The assistant plays a very important rôle in any operation. Occasionally, his move is the most important one and the operator must not forget to assist him. It is well if the assistant has had some surgical training, but in any event he must be interested in the technic of the operation and take every opportunity to improve his own technic. Too many assistants think of themselves only as sterile hod carriers for a high priced brick layer and in so doing they often cease to be sterile. In rural practice, as well as in the city, the patient is safest in the hands of a well trained operating team. If residents are not available, it is well to make use of members of the staff who show interest in and aptitude for surgical technic. Smooth team work requires working together and this is certainly every bit as important in the removal of an appendix as it is in scoring a touchdown or completing a triple play.

The operating room nurses, both the scrub nurse and the circulating nurse, should think of themselves as members of the operating team. They should make themselves acquainted with the technic and methods of each operator and anticipate his needs, so that he does not have to break his train of thought, which is the guide to his technic. A scrub nurse should

have more than a speaking acquaintance with anatomy, so that she can intelligently follow the steps of the operation. It is one of the duties of the surgeon to take every opportunity to instruct her in this, in order that her knowledge of and interest in anatomy will increase.

I have offered a plea for more interest in appendicitis on the part of the physician, even though it may not fall to his lot to take the leading rôle in the most dramatic part of the treatment. I must not close without mention of consultations. The surgical consultant should be called often and early in suspected appendicitis, but should not necessarily recommend operation. So often the surgeon is called when the need for operation is evident to everyone in the house and the optimum time for operation is past. Physicians and surgeons alike are responsible for this. When all surgeons begin to consider themselves as students of surgery and not just operators and physicians begin to recognize them as such, the mortality rate from appendicitis will drop. An intelligent discussion of a case of abdominal pain and a painstaking explanation of why operation is not indicated will gain more respect, if not fame, for the surgeon than the blunt statement, "She must be rushed to the hospital." Of course I do not advocate this explanation when operation is indicated. One of the patients in this series, who died, was seen by one physician who did not go back to see him after his first examination. He was seen by another physician on the third day and surgical consultation was then asked for. He had peritonitis complicated by diabetes mellitus. The other patient had his onset one evening, was seen by a physician the following day and surgical consultation asked for twenty-four hours later. This was forty-eight hours after the onset. His appendix had not perforated, but the disease was far advanced.

Dennis[13] discussed consultations in appendicitus very intelligently, in a paper read before the Kings County Medical Society, (Brooklyn) in 1903. He said, "Beside the duty which belongs to the family physician, and the duty which develops upon the practical surgeon, there is still a common reciprocal duty which belongs to both. The mortality in appendicitis can be reduced only by a hearty, cordial co-operation of both physician and surgeon, and when these relations are established, the death rate, small as it is, will be still further reduced, and both physician and surgeon can, by united action, contribute to the comfort and salvation of the patient. It is in this way only that the death rate can be reduced and until the family physician and practical surgeon meet on a common ground, and consult in perfect harmony, the death rate will remain where it is." That is as true now as it was thirty-nine years ago.

SUMMARY

The history of appendicitis has been briefly reviewed and a plea made for a renewed interest in this disease on the part of all physicians.

A series of one hundred consecutive cases of acute suppurative appendicitis, with two deaths, has been presented. In twenty-five of these the appendix had perforated with one death—a mortality rate of 4.0 per cent. In the seventy-five cases without perforation there was one death—a mortality rate of 1.33 per cent. The mortality rate for the entire series was 2.0 per cent.

These attacks occurred for the most part in young and middle aged patients, 70 per cent being less than thirty years old and 80 per cent less than forty.

The symptoms as seen in this series have been presented as follows: pain, tenderness, rigidity, vomiting, rapid pulse, fever, leucocytosis, diarrhea and constipation. The constant presence of pain, although not usually severe, and the overwhelming frequency of tenderness and rigidity have been pointed out. Nausea and vomiting in

association with abdominal pain have been emphasized as of major significance.

The importance of early diagnosis and operation and their relationship to mortality and morbidity has been stressed.

The danger of laxatives has been reiterated.

Treatment has been discussed with a plea for early operation.

The advantages of certain points in technic have been mentioned.

A frank statement of the need for more and earlier consultations in suspected appendicitis and a discussion of the responsibilities of both physician and surgeon have been presented.

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PREOPERATIVE HEMO-IRRADIATIONS

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PREOPERATIVE protection by the Knott technic of ultraviolet blood irradiation therapy has been studied for the past five years at Shadyside Hospital in Pittsburgh. Since 1937, approximately 4,500 ultraviolet blood irradiations have been administered to about 1,500 patients. Those cases in which this therapy was administered preoperatively followed a subsequent postoperative course that merited a detailed study of its use as a protective preoperative measure.

This therapy has been used for the successful treatment of different types of septicemias as reported by Hancock and Knott,[1] Barrett,[2] Miley,[7] Rebbeck,[3-6] Miley and Rebbeck,[8] and Hancock.[9] The rationale of ultraviolet blood irradiation therapy and the known reactions taking place following administration in cases of septicemia indicated it should prevent the development of septicemia. Further the known reactions and rationale indicated that definite protection should be afforded the patient against postoperative reactions when the operative risk is of questionable nature.

The primary field of clinical investigations was that of incomplete septic abortion as reported by the author. This paper described a radical and successful treatment consisting of preoperative ultraviolet blood irradiation therapy followed by dilatation and curettage, using a sharp curet as in clean cases. Our experiences in other pathological conditions show that ultraviolet blood irradiation therapy used preoperatively is a safe procedure, permitting radical and advantageous departure from conventional treatment of at least the following diseases and in the following manner:

1. *Acute Rheumatic Fever and Rheumatic Arthritis.* Tonsillectomy and adenoidec-tomy as well as teeth extractions in the early acute febrile stage.

2. *Multiple teeth extractions* in bad risks from the standpoint of mouth sepsis and cardiac conditions, particularly coronary thrombosis.

3. *Bad Thyroid Risks.* Partial or complete thyroidectomy in one stage.

4. *Incomplete Septic Abortions.* Prompt dilatation and curettage in the febrile stage.

5. *Acute Cholecystitis.* Immediate cholecystectomy.

6. *Lymphangiitis, Lymphadenitis, Cellulitis.* Early localization or disappearance of the infected process.

Acute rheumatic fever with diseased tonsils or abscessed teeth as the focus of infection often present serious problems in treatment. The physician generally has to treat conservatively, fearful of setting up septicemia or a local spread of sepsis by resorting to surgery in the acute febrile stage. Often the result is that by the time it is considered safe to remove these foci the heart has been irreparably damaged.

Frequently the surgeon is faced with a toxic goiter in which the response to preoperative treatment is unsatisfactory, i.e., the basal rate cannot be brought down to a sufficiently low level to be considered safe for operation, or in an elderly patient with toxic adenomas and a bad cardiac risk.

A case of acute suppurative cholecystitis that the best clinical data indicate should be treated conservatively for twenty-four to forty-eight hours to avoid so-called liver shock, which could during this period sustain even more bile duct and liver damage from the infected gallbladder.

In septic abortion because of well grounded fears of spreading infection locally and even breaking down barriers to

produce septicemia, the surgeon is fearful of cleaning out the uterus with resulting pelvic disorders necessitating later pelvic

FIG. 1. A, Case 1.

FIG. 1B.

surgery or even death from septicemia, not to mention the incidence of sterility.

Acute cellulitis with lymphangiitis and lymphadenitis can be a very dangerous problem and in some instances will progress to septicemia.

The foregoing are a few of the pathological conditions which we have observed to have responded very nicely to preoperative blood irradiation therapy and made surgical intervention possible with gratifying

results at a much earlier date than routine treatment would allow.

The procedure of administration of ultraviolet blood irradiation therapy has been described by Miley,[10] and briefly consists of the withdrawal of a portion of the patient's venous blood, citrating it and exposing it to ultraviolet rays of specified wave lengths and intensity for a definite period of time and returning it to the patient.

The following are some types of cases treated for preoperative protection and the results obtained:

CASE REPORTS

CASE 1. No. 99794. Miss G. gave a history of shifting joint pains with swelling, tenderness, and fever for three days prior to admis-

had completely disappeared. The systolic mitral murmur which had been present before operation disappeared. She was sent home on the ninth postoperative day in good condition.
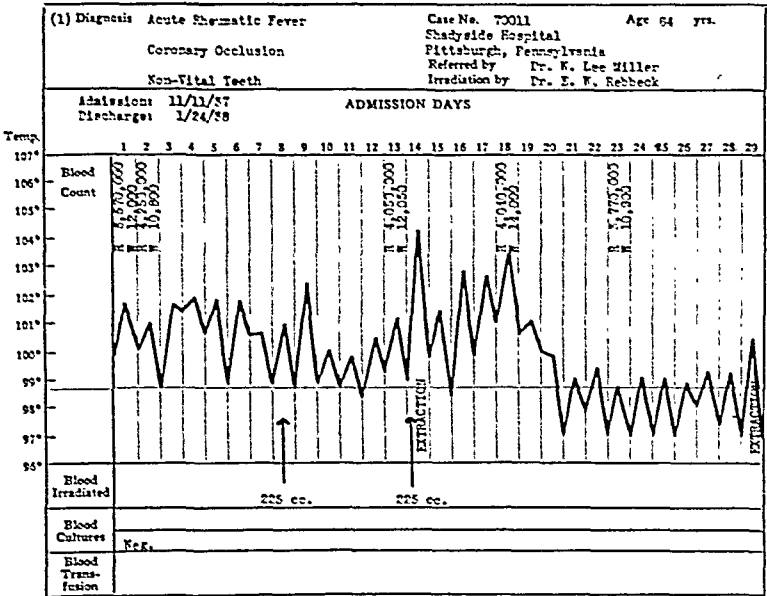
FIG. 2. A, Case II.
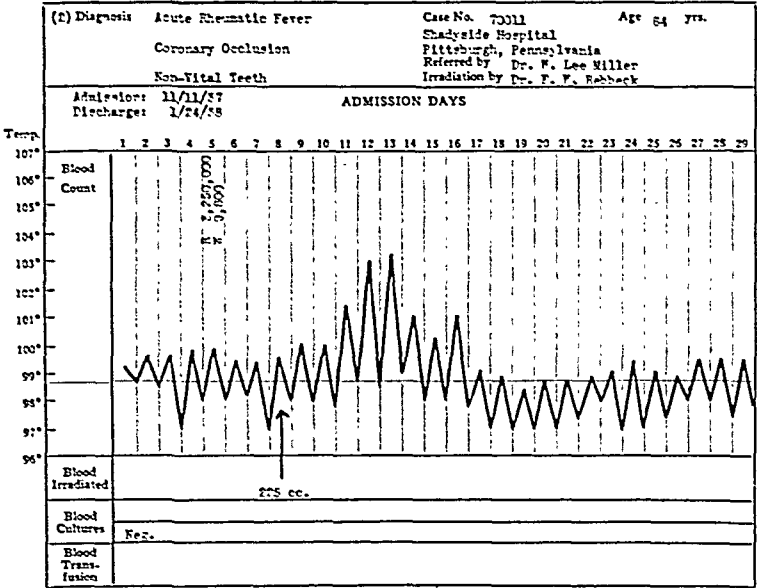
FIG. 2. B, Case II.

sion. It was decided that the tonsils were the cause of this acute rheumatic fever. On the fifth day of her acute illness preoperative blood irradiation was given followed in one hour by tonsillectomy. A transient Staphylococcus albus appeared in her blood stream immediately after operation. No untoward symptoms developed. Her sedimentation dropped from 76 mm. in one hour to 12 mm. in one hour. On the sixth postoperative day joint symptoms

One month later a peri-apical abscess of the lower left first molar developed, and her joint symptoms began to recur. She was readmitted. Another preoperative blood irradiation was given. The tooth extracted, and this time a transient hemolytic streptococcus appeared in her blood. However, she convalesced uneventfully and was discharged on the eighth postoperative day completely free from heart complication and joint symptoms.

Extraction after irradiation affords the patient only mild discomfort and healing is accelerated. When one considers the

and complicated by a septic state which by November 18th, presented a semiconscious patient with a temperature of 101°F., pulse 104,
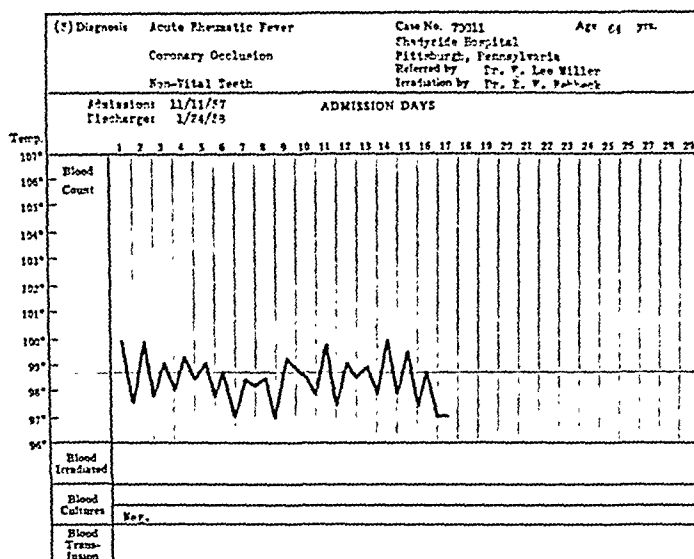
Fig. 2. c, Case II.
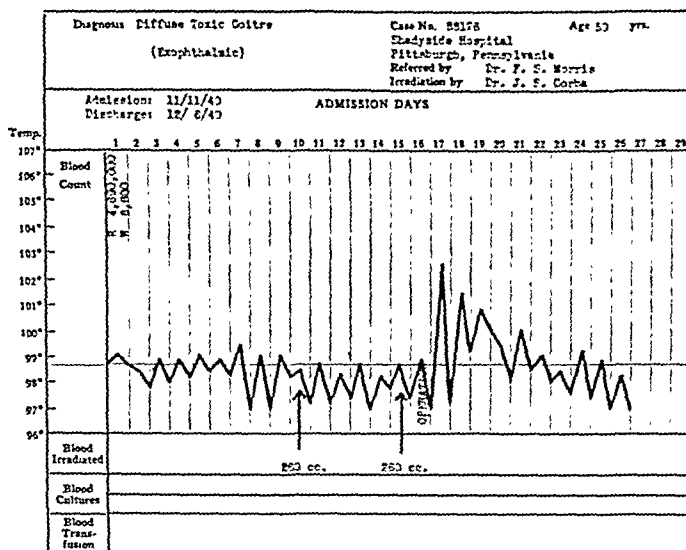
Fig. 3. Case III.

usual conservative method of handling these cases in which so many heart lesions of prominent nature develop, the protection afforded by ultraviolet blood irradiation therapy used preoperatively merits intensive study.

Case II. No. 70011. Mr. G. suffered an attack of coronary occlusion on November 11, 1937, which was considerably relieved the next day, but acute rheumatic fever supervened on this date, became progressively worse

although his blood urea maximum was only 14.4 mg. The patient had a very septic condition of his gums and teeth with nine retained roots in the lower jaw, six nonvital teeth with retained roots in the upper jaw. Blood irradiation therapy was instituted on November 18th. Within three days his joint symptoms had practically subsided. He was mentally alert. His temperature had subsided to 99°F. With joint symptoms recurring progressively worse the next three days it was decided that in view of the septic mouth condition being the

probable focus of his rheumatic fever, extraction was the only possible means of relief. Blood irradiation therapy was again given on November 24th, and the six teeth in his upper

undoubtedly was a life saving measure in this instance. When last heard of this patient was working at his engineering occupation in August, 1938.
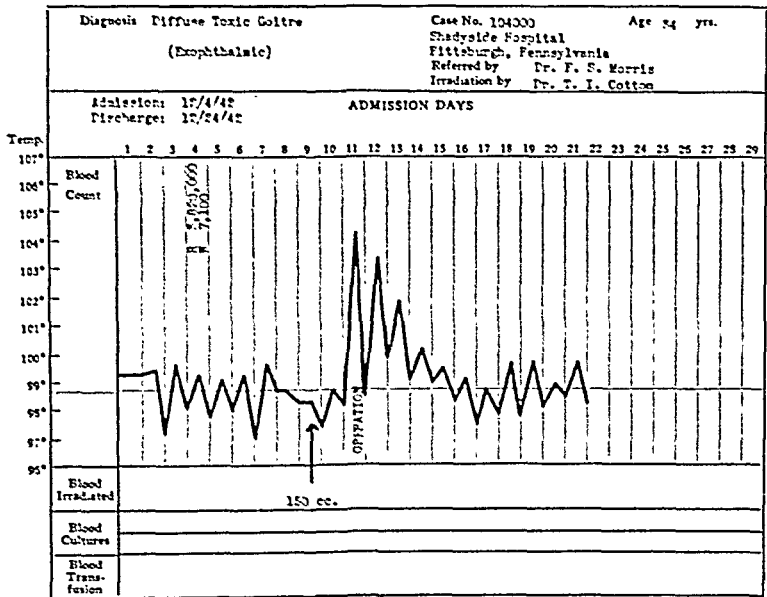
FIG. 4. Case IV.
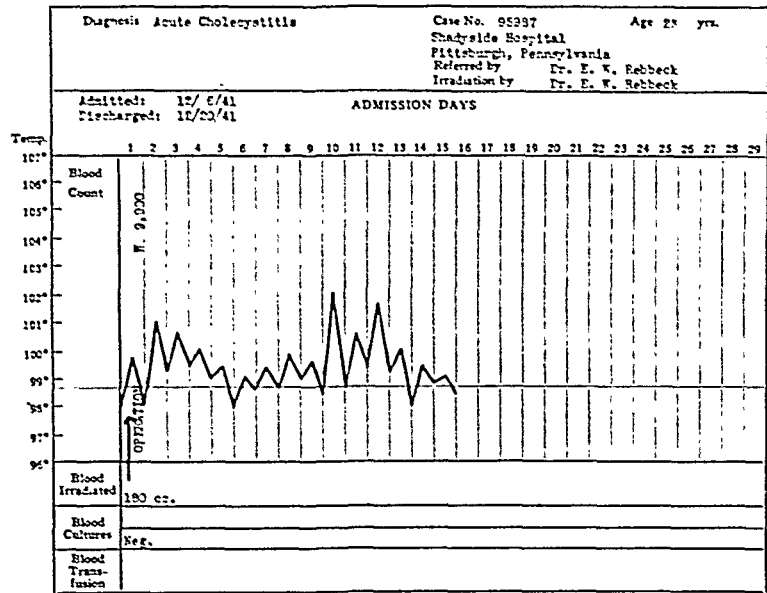
FIG. 5. Case V.

mouth extracted. His peak reaction to this extraction was 103°F. temperature, pulse 120. However, no positive blood cultures were obtained. On December 9th, the remaining nine teeth were extracted, and the peak reaction was 100.4°F., pulse 100. Blood irradiation therapy was again performed on December 17th. The patient was discharged on January 24, 1938, in good general condition. This radical departure in the way of extracting teeth in the presence of acute rheumatic fever

CASE III. No. 88126. Mr. B. had a basal rate on November 11, 1940, plus 86, and plus 62 on November 18th, and plus 62 on November 22nd. Despite rest in bed, Lugol's therapy and phenobarbital. His pulse rate ranged up to a peak of 118. He received blood irradiation therapy on November 20th, and again on November 25th. A thyroid resection was performed on November 27th. His peak reaction was 102.6°F., pulse 136 which had subsided to 99.4°F. temperature and pulse 90 within

forty-eight hours. He was discharged in good condition on December 6, 1940.

Our experience has shown in several other similar cases that preoperative blood

Fig. 6. Case vi.

Fig. 7. Case vii.

Her peak reaction was a temperature of 104.2°F., pulse 104, and within forty-eight hours her temperature had dropped to 100°F., pulse 84, peak. She progressed to normal
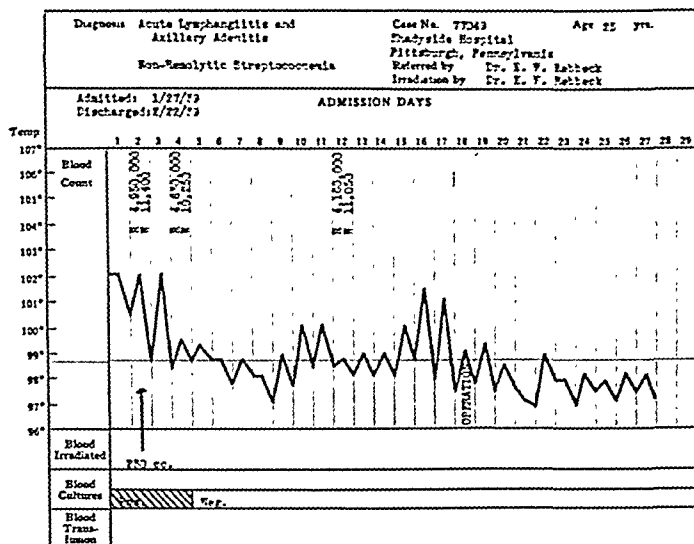
irradiation affords definite protection to this type of goiter which does not respond to preoperative iodine therapy.

CASE IV. No. 10-4000. Miss Y. had a basal rate of plus 76 on December 4, 1942, plus 86 on December 9th, despite rest in bed, Lugol's solution and phenobarbital. Her pulse rate averaged up to 140. She was quite nervous and restless. Preoperative blood irradiation therapy was given on December 12th, and thyroid resection performed on December 14th.

convalescence and was discharged on December 24, 1942. Her basal rate on January 4, 1943, was minus one, and pathological diagnosis, diffuse toxic goiter (exophthalmic).

This type of goiter, we believe, would be a very precarious operative risk particularly for a one-stage operation.

CASE V. No. 95987. Mrs. P. had an attack of acute cholecystitis and was operated approximately ten hours after her attack began. She

was given preoperative blood irradiation therapy. At operation an enormously distended gallbladder was found with quite thick edematous walls and a stone impacted in the cystic duct. As yet the bile was clear.

In this type of case it is our belief from experience in other patients that if some means is afforded to proceed safely with immediate operation, much less damage is apt to result to the bile ducts and cells of the liver. With the exception of an occasional atelectasis no detrimental reactions have been observed in performing immediate operation in acute cholecystitis. From a period beginning December, 1941, through September, 1942, no atelectasis developed in our surgery, and it is our opinion that this sequel did not occur, despite spinal anesthesia, because these patients were treated by postural lung drainage and careful attention was paid to deep breathing postoperatively (in other words we raised the backrest in all cases approximately thirty degrees immediately after operation). Incidentally, no headaches were observed.

We also believed that the bad operative risk, particularly the toxic cases and elderly patients with serious cardiac conditions, went through their operation much better because they were given blood irradiation therapy before operation.

CASE VI. No. 96573. Mrs. C. admitted taking quinine and using a slippery elm stick to produce abortion. She was pregnant about six weeks. Her bleeding on admission was scant, temperature 103°F., pulse 130. The next morning blood irradiation therapy was given and immediately dilatation and curettage performed using placental forceps and a sharp curet. Tissue examination showed necrotizing placental tissue. Her convalescence was uneventful. She was discharged on the fourth postoperative day in good condition.

This type of patient is dangerous to operate upon in this way both from the standpoint of local spread of infection and septicemia. Blood irradiation has been a remarkable protective therapy for these patients.

CASE VII. No. 77049. Mr. J. was admitted with a marked lymphangiitis and axillary adenitis involving the right wrist and arm which occurred from squeezing a small pustule on his wrist. A blood culture taken on admission showed nonhemolytic streptococci. He had severe axillary pain necessitating morphine for its control. The next day blood irradiation was given. His temperature began to recede by lysis. Within twenty-four hours the pain was decidedly relieved; the streaks faded definitely and there was less swelling. Over the next ten days the axilla gradually softened to a point at which incision and drainage was indicated. The same organism was found in the cultured pus. The patient then progressed to an uneventful recovery.

We feel this is an instance frequently observed of localization of infection following blood irradiation. Subsequent blood cultures were negative. In many cases of such a pathological disorder of milder nature the inflammatory process has been seen to subside completely and usually within twenty-four to thirty-six hours.

The foregoing cases were selected for publications as examples of the reactions to surgery when ultraviolet blood irradiation therapy is administered preoperatively. Careful perusal of the charts and case histories show that a safe means of protection is afforded a poor operative risk by use of the Knott technic of ultraviolet blood irradiation therapy preoperatively in at least the pathological conditions mentioned. A marked decrease in the morbidity and mortality in these diseases has been accomplished.

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Case Reports

CERVICAL LESIONS OF BRANCHIAL ORIGIN*

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THE mode of origin and the surgical treatment of sinuses, fistulas and associated lesions located laterally in the cervical region have been the subject of considerable interest to surgeons. An opportunity to treat three patients with affections, presumably of branchial origin, brought the questions of diagnosis and therapy to our attention. One patient admitted with an apparently complete cervical sinus presented a particularly interesting surgical problem. The other two patients offered the simpler therapeutic task of the removal of the cervical auricles discovered during routine physical examinations.

It is generally believed that the view of Rabl[7] is correct that the lateral cervical sinuses, fistulas, cysts and auricles arise from the branchial clefts, usually the second. The branchial apparatus is present in the human embryo from the tenth to about the fortieth day of intra-uterine life. Wenglowski, a Russian surgeon, advanced a second view based upon an extremely careful and lengthy study of the embryology of the cervical region. His work has been reviewed at length by Meyer,[6] who has made it available in English. Wenglowski believed the unobliterated thymic duct gave rise to these congenital abnormalities. Bailey[1] points out that the existence of cartilaginous cervical auricles in the lower part of the neck cannot be explained according to the views of Wenglowski, who stated that branchial remains do not occur below the level of the hyoid bone. The cervical auricles are almost certainly of branchial origin.

The branchial sinuses and fistulas lie laterally in the neck. They may extend from the base of the skull, as illustrated by Case 1 of this report, to a point just above the clavicle medial to the sternocleido-mastoid muscle. They are divided into three types by Bailey:[1] (1) complete fistulas with outer and inner openings, which are usually near the tonsillar fossae; (2) incomplete external sinuses with an outer opening only; and (3) incomplete internal sinuses with inner openings only. The last type is the most uncommon. Douglas[4] described a patient, who was able to distend his neck with air forced from the mouth into the track. The branchial cysts lie, as a rule, anterior to the sternocleidomastoid muscle in the upper portion of the neck. The cervical auricles are found just above the clavicle in close relation to the medial margin of the sternocleidomastoid muscle.

The sinuses and fistulas are lined with stratified squamous or columnar ciliated epithelium; lymphoid tissue and striated muscle are found in the deeper portions of their walls. The cysts present a similar structure with the epithelium commonly stratified squamous in type and with large masses of lymphoid tissue in the

walls. The cervical auricles are composed of fibrous, elastic or hyaline cartilage.

The lesions of branchial origin are removed by operation because of signs of tumor, discharge, or recurrent infection and the possibility of neoplastic alteration. Ewing[5] states that the branchial remains may give rise to either chondromas or deep and often very malignant acanthomas of the neck. Carp and Stout[2] found four probable branchiogenic epithelial neoplasms in a group of 1,538 cancers. They point out, as do Cutler and Buschke,[3] that the diagnosis of branchiogenic carcinoma must not be made unless all possibilities of other primary origin especially in the nasopharynx have been excluded. Cutler and Buschke[3] believe that primary branchiogenic carcinomas are certainly very rare.

Complete surgical removal of the branchiogenic lesions is the ideal method of treatment. The attainment of this object may be quite simple as with the usual case of cervical auricle (Cases II and III). The close proximity of the more extensive lesions to the important cervical structures make their removal more difficult. Furthermore, the lesions are, in part, deeply seated and may be inaccessible for total removal. An incision parallel to the track of a sinus or fistula is commonly used. Bailey[1] has suggested, however, the employment of transverse incisions. After dissection has been carried from the lower incision at the skin opening of the track as high as possible, a second incision is made through which the operation may be completed.

The first case of this report is described in detail because of its interesting surgical aspects. The sinus track reached from above the clavicle to the base of the petrous portion of the temporal bone.

CASE REPORTS

Case I. W. J., a twenty-five year old white soldier, was admitted April 4, 1942. For ten years the patient had been conscious of a small lump just above the inner end of the right clavicle. Two years previously the mass had

been incised and clear fluid obtained. Since then drainage had been intermittent. No food particles had ever passed from the openings. The family history was without significance. Examination disclosed a fluctuant, nontender mass about 2.5 cm. in diameter at the anterior margin of the right sternocleidomastoid muscle just above its insertion into the clavicle. A small amount of purulent fluid could be expressed from small openings through the scar tissue over the mass. A firm narrow cord could be palpated running along the anterior aspect of the sternocleidomastoid muscle up to the level of the hyoid bone. The pharynx was not unusual and the right tonsil presented no abnormalities. The larynx appeared normal on indirect laryngoscopic examination. A diagnosis of lateral cervical sinus of branchiogenic origin was made.

April 10, 1942, with local anesthesia, the swelling was incised to provide adequate drainage, and a portion of skin and wall of a small cavity lined with mucous membrane was removed for pathological study. Histological examination of the tissue demonstrated a segment of epidermis, in which there was some hyperkeratosis and hypertrophy of the rete pegs with chronic inflammatory infiltration. Adjacent to this epidermis there was a zone of transition to a pseudocolumnar ciliated type of epithelium resembling that found in the nasal cavity. No mucous glands or goblet cells were seen. The presence of the two types of epithelium in tissue from this region was considered indicative of branchial origin. Culture of the pus demonstrated nonhemolytic staphylococcus aureus. Tubercle bacilli were not found in smears and no fungi grew on Sabouraud's medium.

The wound was treated with Dakin's solution. A probe could be passed 4 cm. up the track from the skin edge. Iodochloral was injected into the track, and roentgenograms (Fig. 1) showed it reaching from the second thoracic to the sixth cervical vertebra.

Operation was performed April 23, 1942, with an intratracheal tube in place. Open drop ether anesthesia was used with insufflation, when necessary, late in the operation. An incision encircling the scar tissue around the opening of the track at the base of the neck was extended upward along the anterior margin of the sternocleidomastoid muscle for 10 cm. The track itself was readily removed by sharp dis-

section from beneath the platysma muscle and from the sternocleidomastoid muscle. At the level of the hyoid bone, the track passed deep
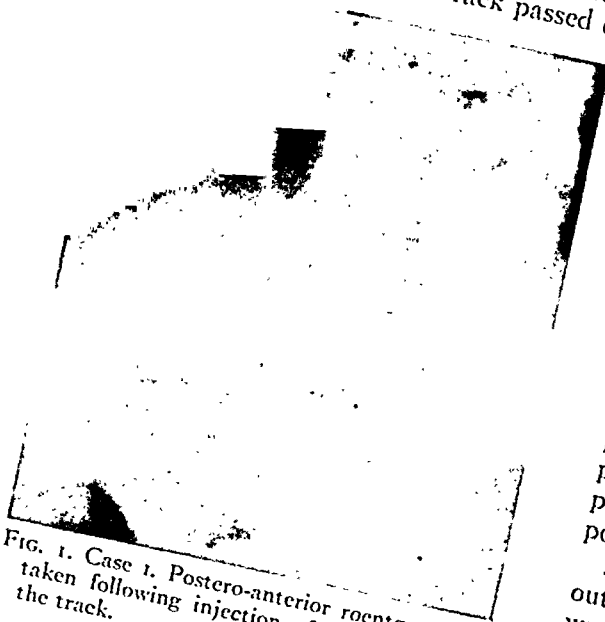
FIG. 1. Case 1. Postero-anterior roentgenogram taken following injection of iodized oil into the track.

into the neck. The external jugular vein was doubly ligated and divided to facilitate exposure. The track lay behind the internal jugular vein and just above the bifurcation of the common carotid artery passing between the internal and external carotid arteries. Dissection was carried out along the medial aspect of the internal carotid artery to a point behind the right tonsil. A finger introduced into the mouth identified a finger in the superior portion of the cervical wound, from which it was separated by the superior constrictor pharyngeus muscle and the oral mucous membrane. The tonsil and the posterior tonsillar pillar could be displaced forward by the finger in the cervical wound.

A tonsillectomy was performed by blunt dissection and snare with especial care employed to preserve the tonsillar capsule and the palatoglossus muscle. A curved clamp was then passed into the cervical wound and identified by a finger resting in the tonsillar fossa. The clamp was gently pushed through the superior constrictor pharyngeus muscle. The sinus track was divided in the cervical wound. The lower end of the upper portion was transfixed with a heavy silk suture and drawn into the mouth through the opening in the superior constrictor pharyngeus muscle.

A moderate degree of tension was placed on the transfixed track, and the superior constrictor pharyngeus muscle was split vertically. The track was bluntly dissected upward. When the upper margin of the tonsillar fossa was reached, the lateral pterygoid lamina was identified by palpation. The palatoglossus and palatopharyngeus muscles were divided superiorly to facilitate exposure. The levator veli palatini muscle was split, and the orifice of the eustachian tube was identified by palpation. With strong traction of the track, the dissection was carried up lateral to the nasopharynx. The track ran lateral to and slightly anterior to the mouth of the eustachian tube and passed posteriorly in its upper portion. A finger pressed into the soft tissues in this region could palpate the hard petrous portion of the temporal bone.

Since further dissection could only be carried out blindly with considerable risk, the track was divided and the upper 3½ cm. allowed to drop into the nasopharynx. It was thought that this portion of the track would be contained in the soft tissues behind the nasopharynx with its orifice on the posterior superior portion of the palatoglossus muscle. The track could then drain freely into the nasopharynx.

The incision connecting the oral cavity with the cervical wound through the superior constrictor pharyngeus muscle was closed with interrupted plain catgut sutures. The superficial cervical fascia and the platysma muscle were closed with interrupted chromic catgut sutures and the skin with interrupted fine silk sutures. Penrose drain sheaths were brought out in the mid and lower portions of the wound, respectively, from the upper and lower cervical regions dissected.

The patient's convalescence was without event. The highest temperature attained was 99.2°F. the day of operation. The drains were removed on the second postoperative day and the sutures from the skin on the fourth day, on which date the patient was allowed out of bed. May 15, 1942, examination showed the tonsillar fossa to be healed and indirect mirror examination of the larynx showed it to be normal. Indirect nasopharyngeal mirror examination demonstrated a small accumulation of granulation tissue on the posterior superior surface of the palatoglossus muscle, presumably the opening of the remaining portion of the

track. A healed scar was seen running up to the orifice of the right eustachian tube. A bougie was readily introduced into the eustachian tube. The cervical wound was nicely healed.

It was believed that the position of the orifice of the track was quite satisfactory since it was well removed from contact with fluid and food during deglutition.

May 20, 1942, a left tonsillectomy was performed with local anesthesia. The soldier was discharged to duty June 5, 1942.

Histological examination of the excised tissue (Fig. 2) demonstrated in sections from the lower portion adjacent to the skin a lumen lined with columnar epithelium. Sections from the mid and superior portions showed a lumen lined by ciliated columnar epithelium with gland-like pouchings. The lumen was filled with inflammatory débris. The surrounding tissue was densely infiltrated with lymphocytes. Further from the lumen hyalinized fibrous tissue surrounded, in turn, by striated muscle was found.

The described case illustrated probably a truly complete branchial sinus. The roent-

since they may give rise to true neoplasms benign or malignant.

Case II. I. K., a twenty-three year old white soldier, was admitted April 9, 1942, and
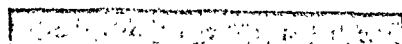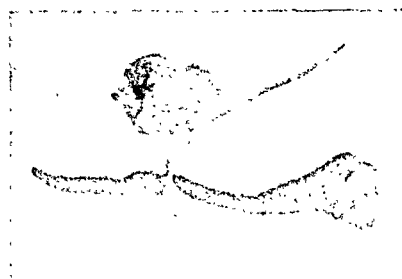
Fig. 2. Case I. Excised sinus track and right tonsil.

discharged after treatment for a gastrointestinal complaint May 12, 1942. During routine physical examination a freely movable mass (Fig. 3) about the size of the tip of a thumb was found at the anterior lower margin of the left sternocleidomastoid muscle. Its consistency

Fig. 3. Case II. Photograph of cervical auricle.

genographic examination was misleading since it did not delineate the full length of the track. Removal was carried out through a combined cervical and transoral operation including tonsillectomy. Marsupialization of the superior portion of the track was adopted as the most safest method of disposition.

The simple surgical problem of treatment of the cervical auricles is shown by two cases. These congenital lesions should be removed since they are disfiguring and

was that of twisted cartilage. A diagnosis of branchial cleft developmental abnormality was made. The lesion had been present since birth. The entire mass was readily excised through a transverse incision with local anesthesia.

On section of the removed tissue a small portion of cartilage was found beneath the skin. Histological examination demonstrated incompletely developed elastic cartilage surrounded by normal skin and subcutaneous tissue.

Case III. W. C., a twenty-one year old white soldier, was admitted April 11, 1942, and

discharged April 30, 1942, following treatment of a dermatological complaint. During physical examination a small, smooth mass probably containing cartilage was found lying above the right clavicle. It was slightly elevated above the skin level and lay anterior to the right sternocleidomastoid muscle. The swelling, which had been present since birth, was about 2 cm. in diameter. A diagnosis of cervical auricle was made. The mass was readily excised through a transverse incision with local anesthesia.

On section of the excised tissue a small cyst-like space was found lined with dense friable tissue. Histological examination showed small nodules of adult elastic cartilage separated by bands of fibrous tissue.

SUMMARY

A brief review of the developmental background of the lateral cervical sinuses, fistulas, cysts and auricles has been presented. In all likelihood they are of branchial cleft origin. Surgical excision is the recommended treatment as shown in the cases described.

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OSTEOCHONDROFIBROSARCOMA OF THE BREAST*

CASE REPORT

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SARCOMA of the breast of all types represents 0.3 to 9.0 per cent of all malignant tumors, the higher percentages occurring in the figures of the earlier authors. This is explainable on the basis of two factors: First, all cases of cystosarcoma phyllodes were classed as malignant, and secondly, many tumors which were called round cell sarcoma, are now thought to have been anaplastic forms of carcinoma.

Classification of sarcoma of the breast was for many years in a hopelessly muddled state, largely because of the rarity of these tumors. Much of the older literature is worthless, since the only grouping made, was on the basis of cell shape, i.e., "spindle cell," "round cell," and "giant cell" sarcoma.

Fox, in 1934, was one of the first to present a comprehensive classification, based on histogenesis. He divided the connective tissue of the breast into four types: (1) *Intralobular*—giving rise to intracanalicular fibro-adenoma, and cystosarcoma phyllodes, both benign and malignant; (2) *perilobular* —giving rise to pericanalicular fibro-adenoma, and adenofibrosarcoma; (3) *interlobular*, and (4) *interlobar*—both giving rise to pure fibroma, (extremely rare) and true fibrosarcoma.

Thus, it may be said that there are three types of fibrosarcoma arising from the connective tissue of the breast; cystosarcoma and adenofibrosarcoma, in which tumors there occurs an active proliferation of the epithelial as well as the connective tissue elements; and true fibrosarcoma, which contains fibroblasts alone.

Besides fibrosarcoma, a few cases of liposarcoma, neurogenic sarcoma, leiomyo-sarcoma, rhabdomyosarcoma, etc., are reported. Lymphoblastoma is occasionally seen, usually in conjunction with disease of the lymphatic system elsewhere, since there is normally no lymphoid tissue in the breast. Another rare and interesting tumor, the so-called "carcino-sarcoma," is discussed at greater length below.

CARTILAGE AND BONE IN BREAST TUMORS

Cartilage, osteoid tissue, and bone are reported as occurring in those growths containing active epithelial elements, (e.g., Davidsohn—in cystosarcoma; Miller and McCarty—in adenofibrosarcoma) and in those which do not (e.g., Sailer—in true fibrosarcoma). Thus on a histogenetic basis, these tumors cannot be classified as a distinct subgroup of fibrosarcomas.

The origin of these tissues is a matter of considerable dispute. Various authors maintain that they arise from: (1) Ectopic groups of cells which would normally go into the formation of the thoracic cage; (2) rests of totipotent embryonal cells; (3) metaplasia of fibroblasts.

This resolves itself into an argument as to whether these tissues arise from cell rests, that is, that the characteristics of the tissues formed depend on properties inherent in the chromosomes of the cells which give rise to them, with variation possible on a basis of mutation alone (theories 1 and 2); or whether they arise as the result of the action of local biochemical changes on the primitive fibroblast (theory 3).

The most baffling tumor is the carcino-sarcoma, which consists of intimately intermingled areas of carcinoma and sarcoma. Several cases are reported in which cartilage

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and bone have been observed in the sarcomatous areas (Tudhope, Kreibig). Many authors regard these tumors as teratomas, discovered cartilage in the sarcomatous areas (Haagenson, quoted by Stout). The most conclusive evidence for the meta-

FIG. 1. Osteochondrosarcoma of the breast.

FIG. 2. Osteochondrosarcoma of the breast; lateral view.

others believe that they arise from the "collision" of separate tumors growing in the same area; while the newer concepts from the experimental school state, that they are formed as the result of a local physiological status which excites both the epithelium and connective tissue to the formation of neoplasms.

To support one extreme in the argument, there is the case of McIver, which fulfills the classical description of teratoma, containing cartilage, epithelial cysts, an alveolar process and well formed teeth. Similar cases are reported by Coues, D'Allaines and Hiely, and Gioia and Bianchi.

On the other side, certain workers, transferring carcinoma in the breasts of mice, found sarcoma arising in the concurrently transplanted connective tissue, after several generations, and in several such cases

plastic theory is advanced by Dunning, Bullock, and Curtis, who induced carcinoma, carcinosarcoma, and sarcoma, including osteochondrosarcoma, by the subcutaneous injection of 3, 4-benzpyrene into the breasts of rats.

The infrequent incidence of cartilage and bone in the breast may be appreciated by examining the figures collected at some of the larger clinics. In 1915, Geist and Wilensky reviewed the literature as far back as 1858, and collected 435 cases, among which, they found seventeen cases reported to contain one or both of these tissues, roughly 4 per cent. More recent figures are as follows: Bishop, one case in twenty-four; Fox, one in sixty; Miller and McCarty, one in thirty-five; Sailer, two in fourteen; Stout and Hill, three in twenty. A compilation of these series

yields an approximate incidence of 5 per cent.

Articles dealing specifically with this subject are largely isolated case reports. However, in 1937, Raso made an exhaustive search of the literature, and collected seventy-five tumors of all types containing cartilage and bone. Most of these are, from his histological descriptions, fibrosarcomas. Further search in the journals available to us has revealed several more such cases, and we were also fortunate enough to observe one.

CASE REPORT

J. K., a forty-eight year old negress, was admitted to Bellevue Hospital on November 2, 1941. Her complaint was a large swelling of the left breast. She stated that it had started eighteen months previously, and had recently grown very rapidly, with the development of a large, foul-smelling ulcer four weeks before admission. She denied weight loss, weakness and other constitutional symptoms.

Her past history was significant in that she had malaria in 1922, and was suspected of having pulmonary tuberculosis in 1938, which was never proved. There was no venereal history. She was married and separated having had eight normal deliveries. Her menopause occurred four years ago.

Physical examination showed a fairly well developed and nourished negress in good general condition. Detailed examination was essentially negative except for an enormous enlargement of the left breast, with a big, foul-smelling ulcer medial to, and below the nipple. (Fig. 1.) The mass was irregularly nodular in contour, of the consistency of firm sponge rubber, and slightly tender on palpation. A few small lymph nodes were palpable in the left axilla. The right breast was normal.

It was believed that the size of the mass and the ulceration justified a palliative mastectomy which was performed on November 5th. The entire breast and the pectoral portion of the pectoralis major were removed. In the region of the sixth costochondral junction was a small area where the tumor apparently infiltrated the chest wall. The wound was left wide open, the area being partially covered with about twelve Thiersch grafts.

The patient went into shock after the operation but responded to supportive therapy. The grafts took well, and the wound appeared

FIG. 3. Osteochondrosarcoma of the breast. Photograph showing chest wall with Thiersch grafts and beginning recurrence.

in good condition at first, but within three weeks, there was evidence of a local recurrence at the site where the tumor had invaded the chest wall. (Fig. 2.) This mass grew very rapidly, and roentgenograms of the chest showed a considerable spread in the lungs. In spite of an extensive course of radiotherapy, the patient followed a downhill course, and expired on the fifty-second postoperative day. Permission for postmortem examination was refused.

Pathological Description. The specimen (Fig. 3) is a large breast from a colored female, measuring 25 cm. in diameter. Nipple, and skin over most of the mass appear normal, but about 8 cm. medial to the former is a large shallow ulcer 10 cm. in diameter with proud edges. The base is formed by friable yellowish tissue and covered with foul slough. On section, there is a narrow band of connective tissue

just beneath the skin in which a few breast ducts can be made out. Invading this layer and the skin to form the base of the ulcer and

mass is formed by a thin layer of fibrous tissue, fat, and the remnants of the pectoralis muscle. At one point, there is a small area where the

FIG. 4. Photograph showing cross section of the tumor with necrosis of central portion.

FIG. 5. Low power magnification, showing different types of cells, osteoid deposits, cartilage, etc.

extending down almost to the plane of surgical excision is a mass of smooth, fairly firm, white tissue, which is semitranslucent and resembles fish flesh. Extensive necrosis has occurred in the center of the mass, resulting in the formation of a cavity 10 to 12 cm. in diameter, which communicates by a small sinus with the ulcer on the surface. The walls of the cavity are ragged and friable and it is filled with necrotic and hemorrhagic débris. The under side of the

tumor tissue appears to have perforated this layer.

Microscopic examination of sections taken from the surface of the breast reveal stratified squamous epithelium, beneath which is a narrow layer of areolar connective tissue containing a few breast ducts, normal except for compression. Under this layer, and invading it from below, is seen a large mass of abnormal connective tissue cells. For the most part,

TABLE I

Author	No. of Cases	
Anzillotti	1	*Arch. ital. di med. Sper.*, 3: 513, 1938.
Arnold	1	*Virchow's Arch.*, 148: 451, 1897.
Banet, Bolanos and Sutter	1	*Boll. Liga contra el Canc.*, 8: 321, 1932.
Barst	1	*Allg. Path. d. mal. Geschwuelste, Leipsig*, 1924.
Battle	1	*Lancet*, 1: 177, 1901.
Berner	1	*Ztschr. f. Krebsforsch.*, 46: 232, 1937.
Biehl	1	*Beitr. z. klin. Chir.*, 140: 52, 1927.
Billroth	1	Die Krankheit der Weiblichen Brustdruese. Stuttgart, 1886.
Bishop	1	*J. M. A. Georgia*, 30: 232, 1941.
Bowlby	1	*Tr. Path. Soc. London*, 35: 306, 1882.
Busch	1	Chirurgische Beobachtungen, Berlin, 1854.
Busser	1	*Ann. d'anat. path.*, 6: 1247, 1928.
Chevrier and Delval	1	*Bull. et mém. Soc. anat. de Paris*, p. 723, 1910.
Clarke	1	*Tr. Path. Soc. London*, 41: 229, 1889.
Coen	1	*Boll. Sci. Med. Bologna*, series vii, vol. 2 (quoted by Raso).
Cornil	1	Les Tumors du Sein. Paris, 1908.
Cruveilhier	1	*Traite d. anatomie Path.*, Paris, 1908.
D'Aunoy and Wright	1	*Ann. Surg.*, 92: 1059, 1930.
Davidsohn	1	*Centralbl. f. Gynäk.*, p. 1357, 1909.
Durham	1	*Brit. M. J.*, 11: 1019, 1883.
Dyke	1	*Brit. J. Surg.*, 14: 323, 1926.
Edelmann	1	*Beitr. z. path. Anat. u.z. allgem. Path.*, 78: 618, 1927.
Fox	1	*Ann. Surg.*, 100: 401, 1934.
Freshman and Kurland	1	*Rocky Mountain M. J.*, 37: 981, 1940.
Fry	1	*J. Path. & Bact.*, 30: 529, 1927.
Goemori	1	*Am. J. Surg.*, 33: 150, 1936.
Happel	1	*Beitr. z. klin. Chir.*, 12: 619, 1894.
Hartmann et al	1	*Bull. Assoc. franç. p. l'etude du cancer*, 22: 378, 1933.
Heurtaux	1	*Bull. Soc. Anat. de Paris*, 1: 15, 1879.
Horner	1	*Beitr. z. klin. Chir.*, 12: 619, 1894.
Hueter and Karrenstein	1	*Virchow's Arch.*, 183: 495, 1906.
Jaki	1	*Deutsche Ztschr. f. Chir.*, 219: 413, 1929.
Kaufmann	3	*Trattato di anat. Path.*, 1930 (quoted by Raso).
Kreibig	1	*Virchow's Arch.*, 256: 649, 1925.
Kreutzfeld	1	Kiel Diss. p. 195, 1931, (quoted by Raso).
Kurosu	1	*Ztschr. f. Krebsforsch.*, 26: 99, 1927.
Lecene	1	*Rev. de chir.*, 33: 434, 1906.
Leriche and Cavaillon	1	Soc. Anatomie, 1908, (quoted by Raso).
Miller and McCarty	1	*Surgery*, 6: 746, 1939.
Morton	1	*Tr. path. Soc. of London*, 4: 127, 1904.
Nadal	1	*Bull. Cancer*, 1910, (quoted by Raso).
Neal	1	*South. M. J.*, 25: 841, 1932.
Orlando	2	L'Ospedale Magiore. Vol. vi, series ii, p. 519, 1913, (Raso).
Raso	1	*Patbologica*, 29: 229, 1937.
Rotolo	1	*Soc. Lombard. di Chir.*, 13: 1935, (quoted by Raso).
Sahrt	1	*Beitr. z. klin. chir.*, 55: p. 574, 1907.
Sailer	2	*Am. J. Cancer*, 31: 183, 1927.
Schreiner and Thibaudeau	1	*Ann. Surg.*, 95: 433, 1932.
Schultz-Brauns	1	*Henke-Lubrasch Handbuch*, 7: 2, 235.
Speer	2	*Frankfurt Ztschr. f. Path.*, 53: 39, 1938.
Stefanini	1	*Gazz. d. osp.*, 71: 564, 1888, (Raso).
Stilling	3	*Deutsche Ztschr. f. Chir.*, 15: 247, 1881.
Stout and Hill	3	*Arch. Surg.*, 44: 723, 1942.
Thinnes	1	*Virchow's Arch.*, 264: 150, 1927.
Tudhope	1	*J. Path. & Bact.*, 48: 499, 1939.
Von Hacker	1	*Arch. f. klin. Chir.*, 48: 93, 1894.
Wagner	1	*Arch. f. Heilkinde*, 2: 275, 1861.
Warren	3	Surg. Abst. on Tumors of the Breast, Boston, 1848.
(The case presented)	1	
Total cases	70	

they are spindle-shaped, with large, oval, vesicular nuclei, and scanty cytoplasm. They are loosely arranged in narrow intersecting bands, throughout which numerous round and polygonal cells of varying size are scattered. Mitotic figures are moderate in number. In many places, are multinucleate giant cells of the foreign body type, which are as numerous in intact areas as in those where necrosis has occurred. In some sections, taken from widely separated parts of the tumor, are small islands of cartilage in the midst of fibroblastic elements, and in others are areas of typical osteoid tissue, merging imperceptibly with the surrounding tumor mass. In some of these small masses of calcium are deposited. Several sections from the deeper portions of the tumor show a number of areas in which the usual cell type has been replaced by closely packed masses of the large round cells. The cytoplasm is basophilic, and the nuclei are large, vesicular and contain one or more hyperchromatic nucleoli. Mitoses are very numerous, and each of the groups appears to surround a central blood vessel. Sections from the wall of the cavity reveal massive hemorrhagic necrosis and an acute inflammatory exudate. In sections taken from the plane of surgical excision, several being taken from the suspicious area described, the tumor tissue is found covered at all points by a narrow layer of fibrous and adipose tissue, with a few widely separated areas of striate muscle. *Diagnosis:* Osteochondrofibrosarcoma of the breast.

REMARKS

This represents a case of fibrosarcoma of the breast without the presence of epithelial elements. Therefore, the tumor probably arose from the interlobular or interlobar connective tissue. This type of fibrosarcoma is suggested in the clinical history by the relatively short duration of the mass in the breast.

TREATMENT

The treatment of these tumors differs in no way from that of ordinary fibrosarcoma. Distant metastases tend to occur late, and axillary lymph nodes, which may be enlarged due to secondary infection, are almost never involved by the tumor. Since local recurrence is frequent, excision of the tumor alone is dangerous.

Most surgeons seem to prefer simple mastectomy with or without removal of the pectoral muscles. Some men, because of the difficulty of a definite preoperative diagnosis, also do an axillary dissection.

CONCLUSIONS

1. Cartilage and bone are seen infrequently in tumors of the breast, occurring in approximately 4 to 5 per cent of breast sarcomas.

2. They are seen in all three subtypes of fibrosarcoma.

3. Except in the few cases which comply in all details with the definition of teratoma, cartilage and bone arise in these tumors by a process of metaplasia.

4. A case of osteochondrofibrosarcoma of the breast is presented.

Table 1 lists alphabetically those authors, who have reported one or more cases of breast tumor, having the histological characteristics of fibrosarcoma, and containing cartilage, bone, or both.

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STRICTURE OF THE RECTUM*

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A PROCEDURE designed to relieve stricture of the rectum, without attack upon the stricture itself, sounds rather contradictory. Yet it may well prove to be the simplest way to relieve the symptoms of this common condition.

A rectal stricture is a narrowing of the lumen, usually within three inches of the anorectal line. It is generally annular or tubular: annular when ring-like, tubular when an inch or more in length. It is hard, inelastic, and in those cases under consideration in this article, the result of an inflammatory process. It involves anywhere from one to all coats of the rectum. Its outstanding symptoms are constipation, tenesmus and mucopurulent discharge. Its usual course is that of endless dispensary treatment, dilatation, chemotherapy, incision, ending often in colostomy. The commonest benign etiological factor is lymphopathia venereum. It can be the result of any extensive mechanical, chemical or bacterial injury to the rectal mucosa.

Dissatisfied with tedious and often futile treatment along accepted lines, it was decided to make a more direct attack upon the problem. This surgery was based upon a new principle, one which apparently has not been considered before.

Careful attention to the patient's own description of the difficulty gives a valuable clue. The history always contains one significant statement: "There was great straining with little result; then the stool finally passed when the straining let up." The stool at this time was liquid or semisolid, not in hard particles; it should have been able to pass through the constricted lumen. Why, then, was there such great difficulty, such marked tenesmus? It is significant that the stool was passed after the straining stopped. The thought immediately arose, that it may not have been the small lumen that resisted the passage of the stool. *It was more likely the prolapse of the rectal wall into the narrow stricture,* plugging it and closing it during the period of straining. Inflamed edematous mucous membrane would be especially susceptible to this action.

In order to relieve this prolapsing into the stiff stricture, a new surgical procedure was evolved to deal with these cases. Up to now, all our efforts had been aimed directly at the stricture. We stretched it, incised it or used diathermy on it, with, of course, only temporary enlargement of the lumen. Contraction occurred again promptly, as it does with all circular constrictions throughout the entire gastrointestinal tract. Our chemotherapy (sulfanilamide, etc.), assisted in reducing the inflammation and subduing the organisms or viruses involved, but it surely did nothing to the firm fibrous tissue already formed. Both cases reported here had received sulfanilamide for long periods without any benefit.

Concluding that the stricture is an unyielding band, it was decided to direct all efforts at the prolapsing rectum above it. Fixation of the rectum at this higher level was decided upon as the remedy.

Procedure. An incision is made in the skin between the rectum and the coccyx. This is deepened, passing through the anococcygeal ligament into the posterior rectal space. The finger is then inserted and it bluntly dissects the rectum from

its surrounding structures. It does this posteriorly, then on both sides, and then anteriorly as far as the finger can reach. The outermost aspect of the stricture can

FIG. 1. Incision through anococcygeal ligament.

be palpated, even visualized, and the rectal wall can be freed well above this point. The only upward limitation is that made by the peritoneum. The finger does not readily reach this, and it is not likely to penetrate it even if it does come in contact with it.

Three strips of gauze are inserted, one on each side and one posterior to the rectum. These create local irritations and result in the formation of a broad bed of scar tissue, surrounding the rectum on three sides at least. The rectum practically lies in a trough of scar tissue, and its downward propulsion is prevented. The gauze strips are removed one at a time, each day after the operation. The wound drains pus for three or four weeks, gradually clearing up, and leaving behind it the very desirable bed of scar tissue.

At the time of the operation it is possible to stretch the stricture considerably. It is even possible to incise the outer surface of the stricture, which appears as a white band of fibrous tissue. It is doubtful that this step is advisable, as it has little effect upon the final anatomical result, as subsequent contracture narrows the lumen again. However, this only emphasizes the point of this paper. The small lumen apparently does not produce the symptoms

described by the patient. The symptoms are produced by a prolapse above the stricture, which is prevented by this procedure.
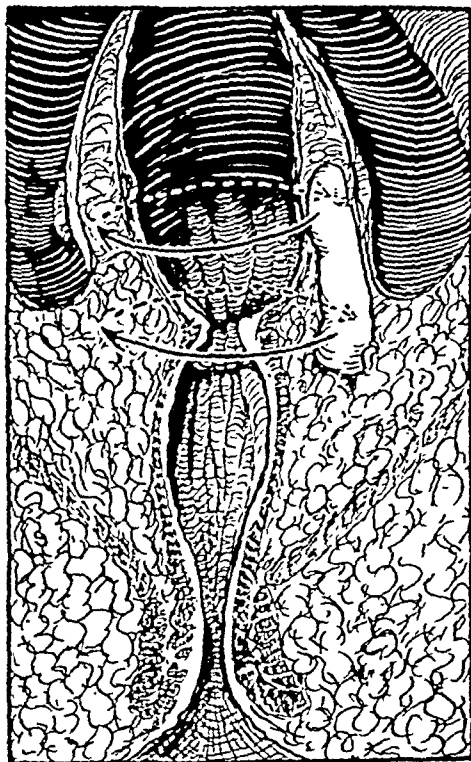
FIG. 2. Finger dissection above stricture.

Postoperative dilatation is not recommended. It apparently adds to local irritation. It is far better to permit the stool, now descending more freely, to dilate the stricture.

The operation was suggested by the procedure devised by Dr. Martin L. Bodkin for prolapse of the rectum in 1912. The first patients on whom this new approach was used were in Kings County Hospital. Both had strictures due to lymphopathia venereum, and had previously received other forms of treatment unsuccessfully.

CASE REPORTS

The first patient, Mrs. R. H. aged forty-two, was admitted October 7, 1941, with a long history of constipation which was gradually becoming worse. She had pain and occasional bleeding as she strained to expel the stool.

She had a positive Frei test and some years ago, had received antiluetic treatment.

The rectum had a tight stricture within easy reach of the index finger. It was about two inches above the internal sphincter, annular, fibrous and unyielding; the lumen was about ⅜ inches in diameter. A small amount of mucous mixed with the stool was swabbed away by means of a cotton applicator. No evidence of malignancy was seen.

On October 13, 1941, the operation was done to relieve this stricture. An incision was made posterior to the anus over the anococcygeal line, two inches in length. The finger was inserted deeply into the posterior rectal space with the aid of some sharp dissection at the level of the anococcygeal ligament. The rectum was then freed mainly by finger dissection, posteriorly and laterally, and as far anteriorly as was possible. Some dense adhesions were encountered and these were severed by sharp dissection. This separation of the rectum from surrounding strictures was carried out well above the stricture itself. The wound was then packed with three long strips of iodoform gauze, one on each side of the rectum, and one posterior to it. The anesthetic was 50 mg. of spinal novocaine.

Postoperatively, the wound drained actively and the iodoform strips were removed at the rate of one per day. Temperature reaction was moderate. On the seventh postoperative day, the stricture was examined and it was found that it could be easily dilated at this stage. It offered so little resistance that the tips of two fingers could be forced into it. (It is to be noted here that this enlarged lumen did not maintain this large caliber; it contracted again partially, but did not again exhibit the symptoms of difficult defecation.)

This patient was followed up in the dispensary after her discharge from the hospital for nine months. She states that she is greatly relieved. She requires mild cathartics, mainly magnesia and oil, but with this routine her bowel movements are satisfactory. They are usually of small caliber, and are produced without straining, pain or bleeding.

Protoscopic examination reveals an interesting condition. When the lumen of the stricture is visualized—(about ½ inch in diameter) and the patient is asked to strain, the mucous membrane on the anterior wall prolapses slightly; the other walls show no motion. No "plugging" of the lumen occurs.

The second patient, Mrs. B. H., had a similar history and findings. She, too, had been given sulfanilamide medication at intervals, in years previous to this, without any effect on the course of her condition. She was forty-five years old, had a positive Frei Test and had received diathermy and negative galvanic current for one year, after which she was referred to surgery. At this time, she frequently fainted with the pain and effort connected with defecation. She stated that the effort was usually unproductive and the bowel movements occurred only after she desisted in her efforts. This history so strongly suggested some type of prolapse into the stricture that she was considered a good subject for this type of operative procedure. A small irregularity in the edge of her stricture was first removed for biopsy and was found to be chronic inflammatory tissue. On November 13, 1941, an operation was done similar to that described in the first instance. The thickened fibrous band at the side of the stricture was so clearly visualized from the posterior aspect that its superficial fibers were divided. The rectum was freed on three sides at least, up to a level well above the stricture. Gauze strips were inserted and the usual drainage occurred.

This patient has been observed for nine months. She finds that mild cathartics are sufficient. She no longer has "fainting spells" in connection with efforts at evacuation. The index finger can be inserted through the stricture and the rectal walls palpated beyond this point. The protoscope demonstrated the same interesting condition found in the first case; the anterior wall is the only wall that moves toward the lumen when "bearing down" is attempted. The lumen does not become occluded by its own mucous membrane.

CONCLUSION

This procedure will relieve the symptoms of stricture by the proper fixation of the mucous membrane above the point of narrowing. This can be accomplished quickly and safely by this relatively simple operation.

POSTOPERATIVE TETANUS

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ALTHOUGH postoperative tetanus rarely occurs in the modern hospital, there is the possibility of its development after any operation. The small incidence is due to the effectiveness of modern sterilization. Its repeated occurrence in any institution is *prima facie* evidence of inefficient application of well established principles of prevention. Three cases of fulminating tetanus following hysterectomy in a total of seventy-five laparotomies done by one of us (G. H. B.) within a period of six years in a negro fraternal hospital of sixty beds warrents a study of the etiological factors involved. These are the only cases of postoperative tetanus he has had and they are said to be the only cases that have occurred in the hospital. The 4 per cent incidence in his work in this hospital as compared to the 1.5 to 3 per cent incidence of tetanus developing in wounds received in trench warfare in the first world war before prophylactic inoculation was practiced is significant.[3]

CASE REPORTS (COLUMBIA, S. C.)

CASE I. M. N., a widow, graduate nurse, twenty-three years of age, had the uterus, both adnexa and the appendix removed for bilateral tubo-ovarian abscess of gonorrheal origin on November 5, 1935. The cervix was not removed; the pelvis was drained. On November 10th, her bowels moved, the abdomen was flat and her temperature was 99°F. On November 11th, she complained of soreness of the face, stiffness of the jaws and of inability to open her mouth. There was swelling and tenderness over the parotid gland on one side. She developed general convulsions with opisthotonos; the temperature reaching 103°F. before death on November 13th. Antitoxin was not obtained. She was given morphine for pain and magnesium sulfate intramuscularly to lessen the severity of the seizures. The blood Wassermann was positive.

CASE II. C. H., single, twenty-five years of age, had the uterus, the appendix and both adnexa removed on June 9, 1937, for chronic pelvic inflammatory disease of gonorrheal origin with an adherent, inflammatory left ovarian cyst extending to the umbilicus. The cervix was not removed. The pelvis was drained. Although her temperature never became normal, her abdomen remained flat and her condition was satisfactory so that feeding was begun June 12th. On June 15th, she developed trismus and died June 18th after having repeated general convulsions. Her temperature reached 105.5°F. She was given intravenously a total of 100,000 units of tetanus antitoxin in five 20,000 unit doses. The blood Wassermann was negative.

CASE III. F. B., single, thirty year-old woman had her uterus, appendix and both adnexa removed on July 7, 1941, for bilateral pyosalpinx and intraligamentary uterine fibroid masses filling the pelvis. The cervix was not removed. The pelvis was drained. Her condition remained good and the bowels moved. On July 13th she developed trismus followed by convulsions and opisthotonos. A total of 50,000 units of antitoxin was given intravenously and 60,500 intramuscularly before she died of respiratory failure July 15th. Her temperature reached 106.5°F. The blood Wassermann was four plus.

Comment. Each of these three cases had subtotal supravaginal hysterectomy done for the relief of chronic pelvic disorders. All had pelvic drainage; all did well until the sixth postoperative day when symptoms of tetanus began. Two died in convulsions on the eighth postoperative day and one on the ninth. There was neither history nor evidence of abrasions about the feet or elsewhere. All were operated upon under spinal anesthesia. In all fluid from spinal tap was negative on culture. In two the blood Wassermann was positive and in one negative. Since the last case the surgeon has given every patient operated

upon by him in this hospital prophylactic antitoxin.

Percapita income in South Carolina is low and the hospital, dependent upon the lowest income group for support, has been able to provide only necessities in equipment. After the occurrence of the second case, the obsolete sterilizer used in the operating room was replaced by one of standard make. Commercial catgut already sterilized in glass tubes has been used exclusively. Instruments are sterilized by boiling. A local nurse with postgraduate operating room training at Tuskegee Institute had been in charge of the operating room for more than ten years.

Factors in this hospital favoring the development of postoperative tetanus have been: (1) Infection from patients having tetanus on admission. From the habit of going barefooted on the farm the negro gets abrasions which, from barn yard contamination, invite the development of tetanus. (2) Contamination from pigeons which have nested in the attic of the old wooden building. The tetanus organism is a habitant of the lower intestine of many animals and birds. (3) Ineffective sterilization of laparotomy sheets which have been made of heavy unbleached canvas instead of lighter weight cotton sheeting. Bleaching removes natural oils and waxes which make cotton fabric impermeable and resistant to sterilization. Such a sheet, folded, is a compact mass too dense for effective penetration by steam.

CASE IV. B. H., twenty-two years of age, an unmarried graduate nurse, after cystoscopic examination February 27, 1942, had a large soft stone removed from the pelvis of the right kidney by Dr. W. R. Barron. The pelvis was not sutured. The cigarette drain was removed March 8th. On March 16th, she complained of difficulty in opening her mouth. Her temperature was normal. On March 17th, it reached 103°F. and she had a general convulsion. The drainage tract was irrigated with hydrogen peroxide. Symptoms having disappeared after 500,000 units of antitoxin had been given over a period of five days the administration was

discontinued. However, rigidity and trismus returned so that before dismissal May 12, 1942, she had received a total of 1,400,000 units. She developed an extreme case of serum sickness which was controlled by histaminase.

Comment. This case of postoperative tetanus developed in a denominational hospital of 100 beds for white patients. The sterilizer is an old model of standard make in which the exhaust had been regulated by steam pressure. It is now regulated by steam temperature at the outlet.

CASE REPORTS (SAVANNAH, GA.)

CASE I. On May 12, 1939, under spinal anesthesia through a midline incision the uterus, the cervix, both tubes, the left ovary and the appendix were removed without drainage from Mrs. O., a white widow, forty-three years of age, because of chronic salpingitis. On May 16th, for the relief of increasing distention from paralytic ileus and septic peritonitis the abdominal wound was opened and the colon was deflated by trocar. A plastic exudate was found over the viscera. The uterine ligament stumps were gangrenous as if from gas bacillus infection. There was foul smelling fluid in the pelvis. Sutures closing the vaginal vault were removed and it was left open for dependent drainage. On May 17th she developed tetanus and died within twenty-four hours in general convulsions. Antitoxin was given intraspinally and intravenously.

CASE II. Mrs. X., thirty-eight years of age, May 12, 1939, through a midline incision had subtotal hysterectomy done for uterine fibroids with removal of both tubes and the appendix by Dr. H. F. The wound was not drained. She developed tetanus on May 17th and died in general convulsions May 18th. She was given 40,000 units of antitoxin intramuscularly and 200,000 intravenously.

Comment. Both patients in Case I and Case II were operated upon in an adjoining room following the amputation of the stump of an infected crushed arm of a man who had been given prophylactic antitoxin on admission the previous week. He died of septicemia without developing tetanus. Both the hysterectomy patients

were operated upon the same day, developed tetanus the same day and died the same day. A child, having an appendectomy done in the same room as the hysterectomies and on the same day had a normal convalescence.

CASE III. A white male, thirty-eight years of age, in 1929, had the left thigh amputated by Dr. Rudolph Matas for gangrene developing seventy-two hours after obliterative femoral endoaneurysmorrhaphy had been done. On January 21, 1931, after a similar operation done by one of us (J. Q.) for aneurysm of the proximal portion of the right femoral artery, gangrene developed and the thigh was amputated in the middle third January 28, 1931. General convulsions began February 4th, and he died from tetanus February 5th; 50,000 units of antitoxin were given intramuscularly and 25,000 intravenously.

Comment. This case was done in the same hospital as the hysterectomy cases. In 1938 new operating rooms were built and modern electric sterilizers installed. However, instruments are still sterilized by boiling.

CASE IV. In 1936, supravaginal subtotal hysterectomy and appendectomy were done upon a negro woman for uterine fibroids by Dr. Charles Usher. The wound was closed without drainage. The patient developed tetanus on the fifth and died on the eighth postoperative day; 100,000 units of antotoxin were given. The operation was done in a poorly equipped negro hospital without facilities for sterilization.

The eight cases of postoperative tetanus reported by us have occurred in four hospitals in none of which in recent tests by Mood have anaerobic spores survived routine sterilization of goods. Five patients have been operated upon by us and three by other surgeons. Four cases have occurred in Savannah, four in Columbia. Four have been in negroes, four in whites; seven in women, one in a man; none have occurred in children. Seven of the eight patients have died, a mortality rate of 87½ per cent. All of the six patients

with hysterectomies have died. All of the cases in women have followed operations upon the genital or the urinary tracts. In every case instruments had been sterilized by boiling.

The comparatively high incidence of the disease after gynecologic operations has been noted in every series of cases. Schmid,[18] in 1937, presented a series which included nine cases of operations on the intestine with nine deaths; twenty-five in gynecologic operations with seventeen deaths and eleven in hernia and hydrocele operations with eight deaths. Poschman,[13] in 1937, notes that Zacherias in 1908 reported 189, Klewart in 1909 reported thirty-three and Peterson in 1910 collected 150 cases, most of which were gynecologic in origin. This with the high incidence of the disease after delivery and after abortion, particularly criminal abortion, suggests that the female genital tract may be the habitat of organisms that have entered from the rectum. However, no tetanus organisms were found in vaginal cultures made for us in 1942 by Mood from 102 white and negro ward patients in Roper Hospital, Charleston, S. C.

Pulvertaft,[10] in 1937, reported a case of tetanus developing after hysterectomy from the use of unsterilized vaginal pads. The recent report of the development of tetanus in experimental animals after the use of sulfanilamide powder in wounds that had been contaminated with the organisms and the citation of a fatal case of tetanus occurring after a pelvic operation in which unsterile sulfapyridine powder had been used in the patient's abdomen has prompted the Food and Drug Administration, after making a study of their bacterial flora, to order sterilization of all sulfa drug powder by the manufacturer at the source.[16]

Matas[14] has attributed two cases of postoperative tetanus that have occurred in his work to infection by organisms already present in the patient's intestine. He advocated catharsis and a diet free from uncooked food for four days before

operation. Wohlgemuth[11] thinks tetanus bacilli that have been harmless intestinal saprophites may be activated to pathogenesis by the trauma of operation. Intestinal infestation varies with environment, farmers and ranchers having a high incidence. Thirty per cent of the people in Peiping, China, were found to have colon infestation,[19] while in Chicago in only one of 100 herniotomy cases were tetanus organisms found.[20] In the first world war the Surgeon General ordered prophylactic antitoxin given before every rectal operation.[17]

We need not apologize that our study has been handicapped by a lack of laboratory facilities. Undoubtedly, the surgical bacteriologist is the greatest need of the hospital of today. In 1938, in answer to a questionnaire, only eight of 137 hospitals in the city of New York claimed to be fully equipped for anaerobic bacteriology and fifteen admitted having no bacteriological laboratories at all.[6] The laboratory should be able to identify the organism in any wound infection and to do special research when required. In 1940, it was recommended by Melaney[5] that the standardization committee of the American College of Surgeons consider the disapproval of hospitals not equipped for adequate surgical bacteriology. Cutler has said, "The explanation of our surgical failures is to be found in the bacteriological and physiological laboratories more frequently than in the anatomical rooms."

We know that the occurrence in the same wound of tetanus bacilli and of anaerobic gas forming organisms is helpful to both and that tetanus is more fatal when occurring with pyogenic bacteria. Conversely, there must be bacteria biologically antagonistic to tetanus. These should be found by experiment and their bacteriophagic action utilized clinically.

The tetanus bacillus, a spore forming obligatory anaerobe, is exceedingly resistant to sterilization. Methods which are effective for pyogenic and vegetative organisms are ineffective for spores. Although the patient's skin at the site of operation can be only cleansed and disinfected, dry goods, gloves, instruments and sutures should have absolute sterilization, the satisfactory accomplishment of which is a technical problem demanding modern equipment and trained personnel.

Packed for ginning by dirty feet into wagons in which stable manure has been hauled for the fertilization of the seed at the time of planting, cotton is infested with tetanus organisms before it reaches the gin. Unaffected by spinning and weaving, living indefinitely in cotton goods, spores find in closed wounds ideal anaerobic conditions for germination, and wool is grossly infested while yet on the sheep.

Although tetanus spores are destroyed in direct contact with steam in ten minutes at 230°F. in four minutes at 240°F. and in one minute at 250°F. to insure sterilization, goods, gloves and instruments should be subjected in the sterilizer for thirty minutes to steam under fifteen pounds pressure at 250°F.[8] Only that higher temperatures may be reached is steam used under pressure. In the sterilizer steam temperature in the heart of the load must equal that applied to the load. Steam penetration lag may be thirty minutes and in obsolete types of sterilizer temperature in the center of packages of goods may never be raised to the boiling point of water. The modern pressure sterilizer is operated in terms of temperature of steam applied to the load which is measured at the coolest place in the sterilizer—the discharge outlet. This is placed at the bottom to permit the escape by gravity of air which, being heavier than steam, settles. When the thermometer in the outlet registers 250°F. the escape valve closes, for at this temperature all untrapped air has escaped. Air and steam do not mix and there can be no bactericidal action of steam on goods in pockets of residual air.

The sterilizer should not be overloaded. With goods loosely packed to facilitate penetration by steam vertical airways should be left between packs. Instruments

should be free from scale, mechanically clean and with locks open so that all surfaces have contact with steam. Walter[1] has perfected a sterilizer for instruments in which steam reaches 273°F. in twenty seconds. All spores are killed in two minutes. Although effective against pyogenic and vegetative bacteria, boiling does not insure the death of tetanus spores.[1] Yet in most hospitals in this section boiling is the only method of sterilization used for instruments.

Every case of tetanus should be a challenge in the prevention of the spread of the infection. Gloves, dressings, instruments, everything coming in contact with the wound should be sterilized or burned. Care should be taken that wound discharge does not escape upon the bedding. If a drop reaches the floor, it should be left covered with chlorinated lime for a day. When the case has terminated the mattress and bedding should be sterilized. If no autoclave is available, they should be burned; for tetanus spores, dormant for years, become active in favorable environment.

Postoperative tetanus has its greatest incidence and its greatest mortality in the newborn. Before asepsis was practiced, in some of the West Indian Islands more than half of the infant mortality among negroes was from tetanus neonatorum, "The eight day sickness."[6] Jewish infants have an additional incidence from circumcision. The incidence of tetanus that develops in the modern hospital after major operations is unknown. Because of the approbrium most cases are not reported. Neither the State Board of Health nor the Duke Foundation has any data on the incidence of postoperative tetanus in South Carolina. All cases of tetanus are listed together and no hospital has specific data on the subject. Undoubtedly, there is a small but a definite incidence generally over the nation. Light or atypical cases may not be recognized and others are recorded without mention of tetanus as a complication. Facts, even about known cases, are hard to obtain. Hospitals are reluctant to give out information about them because of the threat of law suits.

Unsterile catgut has been blamed for the development of tetanus after operation. Although infested in the living state with spores, sheep intestine, after having been made into catgut, is repeatedly heated by reliable manufacturers to 270°F. which insures its absolute sterility. If the infecting organisms were from the patient's own intestine, tetanus would in every hospital be a common postoperative complication of appendectomy; for the application of phenol and of alcohol to the appendix stump before invagination does not kill tetanus spores and if perforation occurs there is peritoneal soiling from intestinal contents. The minimum period of incubation, the extreme virulence of the organism, the rapidly fatal course of the disease indicate in seven of the eight cases reported by us the overwhelming infection occurring at the time of operation.

CONCLUSIONS

We have reported eight cases of postoperative tetanus which we attribute to the use of unsterile goods or instruments at operation. Although the condition is more common in hospitals having substandard equipment, it also occurs in those having the best. This results from inability to sterilize the skin through which the incision is made and from the fallibility in the operation of the sterilizer. Color change from heat in commercial sterilizer controls is unreliable in that it does not prove contact with steam. The sterilizer should be inspected regularly for mechanical defect and goods should have monthly bacteriologic tests with spore-forming anaerobes. The services of a competent bacteriologist should be available to every hospital. If sterilization of goods and of instruments cannot be relied upon, prophylactic antitoxin should be given after every operation. Instruments should be sterilized by steam under pressure and not by boiling. Without wound suppuration and without peritonitis the laparotomy patient may

die from infection by anaerobic spores, a tragedy which absolute sterilization would prevent in most cases.

We are deeply grateful to Dr. G. McF. Mood and to the Bacteriological Department of the Medical College of South Carolina for valuable assistance in the preparation of this paper.

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BACILLUS WELCHII INFECTION OF THE PROSTATE AND ITS TREATMENT*

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A REVIEW of the literature over a forty-six year period fails to reveal a single case of incidental finding of the Bacillus aerogenes capsulatus in the prostate gland.

It is of interest that Welch and Flexner in their original work, when they reported the gas forming organism, included three cases involving "inflamed parts of the urinary tract." All three were postmortem discoveries. Two of the cases were from Dr. Halstead's service: the first following retention of urine due to urethral stricture; the second following retention and hypertrophied prostate. At autopsy the Bacillus aerogenes capsulatus was recovered from the renal pelves, ureters and bladder. The third case was from the service of Dr. Williams, of Buffalo, and Welch and Flexner reported the presence of Bacillus welchii in the calices of both kidneys.

Welch, in his Shattuck lecture of 1900, reported the finding of Bacillus welchii in inflammation of the bladder and renal pelvis without the detection of gas. Since then little has appeared concerning urinary tract infections.

Thirty-two years elapsed before Ferrier and Bliss reported a case in which the Bacillus welchii was cultured from the center of a renal stone, where it remained dormant until a pyelolithotomy caused release of the organism and enabled it to resume its gas-producing capacity.

In 1934, Goldstein and Abeshouse reported the finding of Bacillus welchii in the prostate following perineal prostatectomy. They conclude, however, that the source of the infection may have been a contamination from the rectum.

Mencher and Leiter (1938) report a number of Bacillus welchii infections of the urinary tract. Following up the work of Ferrier and Bliss they were able to isolate the Bacillus welchii in the calculi of three different patients. They likewise report the discovery of this bacillus following one first-stage prostatectomy and one second-stage prostatectomy. Both cases were fatal.

It will be noted that in all of the above mentioned cases this organism was demonstrated following some operative procedure. Some of those reporting concede the possibility of contamination and others make the interesting comment that anaerobic infections may follow operations on the urinary tract due to the incidental presence of these organisms in the urinary organs. This latter idea was first expressed by Welch in 1900. Franck demonstrated in some cases that the lymph channels of the right kidney capsule may be "ultimately related to the appendix and cecum." Stahr by injection studies demonstrated the close connection of the lymphatics of the kidney capsule with the cortex and pelvis. Hutchinson is of the opinion that bacteria may pass from the bowel to the kidney by way of the lymphatics.

Moench, Torry, Reed and Orr have all made the interesting observation that Bacillus welchii is found in large numbers in the large intestine of normal patients. Before the above mentioned observers found the organisms in normal patients, the arerogenes capsulatus had been found as a normal inhabitant in the stomach in cases of achlorohydria and in cases of carcinoma and pernicious anemia.

Schottmüller, Falls, and Bysshe report the gas bacillus with rather surprising frequency in the normal vagina. Curtis, on the contrary, believes that it is only rarely present. In the reported cases about one-third of them were primiparas. This would tend to refute the theory of Stander and Falls that women with relaxed perineal outlets are more likely to have Bacillus welchii.

The incidental finding of this bacterium in the urine has been reported by Weiser; Bennett, Albarran and Cottet; Runeberg; and Moencher and Leiter.

The incidental finding of this organism from the prostatic fluid, so far as the writer can determine, has never before been reported.

CASE REPORT

A sixty-four-year old Hebrew laborer was admitted to Gouverneur Hospital complaining of frequency and nocturia. One year before he had remained under treatment for six weeks at Gouverneur Hospital for nephritis.

His complaints on admission were (1) nausea and vomiting, (2) dryness of the mouth and lips; (3) spells of dizziness; (4) frequent episodes of nocturia; (5) rectal pain; (6) loss of 14 to 15 pounds of weight over a period of one year.

At the age of twenty he had gonorrhea, and chancre without rash at the age of thirty. His luetic condition was treated with intravenous therapy. His hypertension was discovered eight years before. He had suffered from dysuria and nocturia (three to four times) for three years. In spite of his original history of nephritis there was no history of puffiness of lids or leg edema. There was no history of severe childhood disease. Three years before he had one episode of urinary retention with slight hematuria which was relieved by catheter.

The patient's temperature on admission was 101.6°F.; pulse 88; respirations 22. He looked acutely ill and toxic.

The positive physical findings were 3 ounces of residual urine; blood pressure 190/90; hypertensive fundi, with retenitis but no disc change. There was slight edema of the disc. Rectal examination revealed a moderately enlarged prostate, benign in consistency. There

was no bogginess over the entire area of the prostate. There were no external or internal hemorrhoids or fistulas. The anal sphincter was of normal tone.

Laboratory findings were as follows: *Urine:* albumin 3 with a few scattered red blood cells; white blood cells, 10 to 12 per high power field. *Blood:* hemoglobin 50 per cent; red blood cells 2,700,000; white blood cells 6,000; polymorphonucleous 75 per cent; lymphocytes 25 per cent; no irregular forms; sedimentation rate 42/100 mm. per hr.; nonprotein nitrogen 62 mg. per cent; creatinin 1.7 per cent; uric acid 3.8 per cent; carbon dioxide combining power 50 vol. per cent; sugar 98 per cent; cholesterol 270; cholesterol esters 125; blood chlorides 540.

A urological consultation was requested, and it was suggested that the cystoscopic examination should be repeated, in view of the previous cystoscopic findings of intra-urethral prostatic encroachment. The chief complaints at this time were nocturia, dysuria, and perineal pain with radiation to the tip of the penis. Residual urine was 3 ounces. The prostate rectally was moderately enlarged, benign and boggy over its entire area. It did not appear fixed. Prostatic massage and smear and culture of the expressed fluid was advised.

The report of the prostatic fluids and their time intervals follows:

Date	Smear	Culture
6/9/42	Bacillus welchii	Bacillus welchii
6/11/42	Bacillus welchii	Bacillus welchii
6/26/42	Bacillus welchii	Bacillus welchii
6/30/42	Bacillus welchii	Bacillus welchii
7/2/42	Bacillus welchii	Bacillus welchii
7/7/42	Bacillus welchii	Bacillus welchii
7/14/42	Neg. for Bacillus welchii	Neg. for Bacillus welchii
7/18/42	Neg. for Bacillus welchii	Neg. for Bacillus welchii
7/22/42	Neg. for Bacillus welchii	Neg. for Bacillus welchii
7/27/42	Neg. for Bacillus welchii	Neg. for Bacillus welchii
8/3/42	Neg. for Bacillus welchii	Neg. for Bacillus welchii
10/42	Neg. for Bacillus welchii	Neg. for Bacillus welchii

Treatment consisted of combined polyvalent Bacillus welchii antitoxin serum 1 vial twice each day for ten days. During this period 40 gr. of sulfathiazole were given daily for eight days. The latter was administered with caution because of the patient's secondary

anemia and poor kidney function. The sulfonamide blood level remained, surprisingly enough, at 8.9 mg. per cent during the entire course of treatment.

The patient stated that his perineal pain and discomfort in the prostatic area had subsided following the ten-day treatment. The residual urine, however, remained at three ounces and he still complained of diminished urinary stream and nocturia.

Following the third successive negative prostatic culture the patient was cystoscoped under local anesthesia. A No. 24 pan-endoscope was passed through a tight meatus. The bladder was tolerant and its capacity good. The media was clear. The entire bladder mucosa was somewhat congested. Both ureters were visualized and were seen to be exuding clear urine. There was considerable middle lobe enlargement and moderate bilateral lobe encroachment.

A transurethral resection was done under 60 mg. of spinal procaine. A No. 24 McCarthy resectoscope was introduced into the bladder without difficulty. The median lobe and the intruding portions of the lateral lobes of the prostate were resected. All bleeding was controlled with the coagulating current. A No. 24 whistle tip catheter was introduced into the bladder for constant bladder drainage. The patient withstood the procedure well and returned to his bed in good condition. The pathological report of the tissue sent to the laboratory was fibro-muscular hypertrophy of the prostate.

On the second postoperative day the temperature rose to 101°F. The patient was given an infusion of 10 per cent glucose. The bladder return was clear. On his fifth postoperative day the nonprotein nitrogen rose to 125 mg. per cent. He was given a number of infusions. Six days following operation the temperature was normal and the urethral catheter was removed. The patient voided per urethrum without difficulty. His residual urine was 45 cc. Eight days following operation the residual urine was 0. The patient was discharged on the twelfth postoperative day.

The patient was seen three months following his discharge. The voided urine was slightly cloudy. The albumin remained 3 plus. There were scattered pus cells in the centrifuged specimen. Residual urine was 0; nocturia 1 x. He had no difficulty in voiding, and there was no return of his original perineal pain. The prostatic fluid on smear and culture was negative for Bacillus welchii.

REMARKS

The Bacillus welchii, more commonly known as Bacillus aerogenes capsulatus or gas-forming bacillus, is a short, rather broad, non-motile, Gram-positive rod. It grows easily under strict anaerobic conditions. In the animal body it forms capsules and sporulates. A number of culture media have been devised, the most common one known as the stormy fermentation of milk and the characteristic formation of clot, acid and gas. The aerogenes capsulatus is classified into types A, B, C, and D. Only Type A is found in the human body. The two toxins produced by the organisms are known as hematoxin and myotoxin, and these are responsible for the characteristic clinical observations.

The Bacillus welchii can apparently inhabit the prostate gland without gas formation and without exhibiting any clear-cut symptomatology. It seems reasonable to assume that if prostatic cultures were more routinely done and more often grown under anaerobic conditions, the aerogenes capsulatus would be demonstrated more frequently. The organism undoubtedly does play a rôle in some chronic urinary infections and to these may be added the chronic infection of the prostate.

The blood picture which this case presents sharply parallels the findings of Cornell, Herter, Reed, Torry and others. They have all shown that in rabbits suffering from chronic Bacillus welchii infection without gas formation, there is first, a considerable fall in the hemoglobin determination and that this remains low throughout the infection. The color index shows irregular variations. There is a marked depression in the erythrocyte count. There is little known about the leucocytic picture in chronic Bacillus welchii infection, and it is difficult to draw any parallel from the work of animal experimentation since the animals were inoculated intrasplenically.

We should expect in animals that with such a manipulation the leucocytes would show an initial fall, followed by a marked rise.

Long and Bliss (1937) reported the first experimental results of sulfanilamide therapy in Clostridium welchii infections. This work was closely followed by Domagk (1937), who found that uleron was effective on the Fraenkel strain of gas gangrene experimentally. Bohlman (1937) treated three patients with gas gangrene with sulfanilamide following crushing injuries. All three patients had received prophylactic doses of combined gangrene antitoxin which failed to prevent the development of the disease. The cases responded rapidly to sulfonamide therapy. In 1938, Kennedy confirmed these results.

Stephensen and Ross (1940) found that sulfanilamide and sulfapyridine protected mice against small lethal doses of Clostridium welchii, Type A, when injected intraperitoneally. This treatment, however, was found more effective against large lethal doses when combined with serum treatment.

SUMMARY

1. A case of preoperative Bacillus welchii prostatitis without gas formation is reported and its eventual course and cure described. This, so far as I am able to determine, is the first such case to be added to the literature.

2. It is suggested that in cases of chronic Bacillus welchii infection, the blood picture of Cornell and others found in animals is also found in man suffering from a like infection.

3. It is probable that sulfonamide therapy acts as it does in other infections to cut down the rate of multiplication of the bacteria to such a degree that the organisms cannot produce enough toxin to inhibit rapid phagocytosis. This gives the phagocytes an opportunity to rid the tissues of the organisms and with the combined effect of antitoxin serum, recovery from the infection results.

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HYPERTHYROIDISM OF THE JUVENILE FAMILIAL TYPE*

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DURING the past two years our interest in the problem of the juvenile hyperthyroid patient, particularly of the familial type, has been stimulated by observation of two patients in our hospital. The familial aspects and the allied endocrine dysfunctions have been of particular interest. Although these cases may no longer be considered rare, they are of such relative infrequent occurrence as to merit presentation.

A recent excellent comprehensive survey of this subject has been furnished by Moolten and Bruger[1] which makes further summary redundant. We will, therefore, limit our discussion to the salient features as illustrated by our two patients.

CASE REPORTS

CASE I. M. M. Chart No. 129171. The patient, age seven years, was first admitted on the pediatric service January 31, 1941, at which time there was a history of extreme nervousness, increasing prominence of the eyes, recent weight loss and excessive appetite for the past five years. Both parents were living and well. One sister (N. M.) age thirteen, was a diabetic of five years' duration; (I. M.) age eleven, had rheumatic heart disease; (R. M.) age ten had been previously hospitalized for a symptom-free benign goiter not operated upon; A. M. (Case II) age six, had a subtotal thyroidectomy for diffuse hyperthyroidism.

Physical examination revealed a seven-year old white female, well developed but apparently underweight. Marked emotional instability was obvious. There was definite exophthalmos —equal bilaterally, lid-lag and lack of con-vergence. The pupils were equal and reacted normally to light and accommodation. The tonsils were slightly hypertrophied and the anterior cervical lymph nodes were moderately enlarged. The thyroid was diffusely enlarged, soft and nodular on palpation, and a marked bruit was present. The heart rate was 136, sounds intense; murmurs absent; respiration 24. Rectal temperature was normal. Breasts were undeveloped and signs of beginning puberty were absent. A fine tremor of the extended hands was noted. At the time of this first admission the pediatric service decided to continue medical therapy which consisted of absolute bed rest, sedation, and high caloric diet. On March 1, 1941, Lugol's solution (m 2 T.I.D.) was instituted, and later increased to (m 5 T.I.D.). This resulted in a slight lowering of the pulse rate. Surgical consultation a month later noted no improvement. The pulse rate was still elevated (150), and the thyroid gland had increased in size. On April 7th, the basal metabolic rate was plus 7. Lugol's solution was discontinued on April 10th. The pulse rate one week later had increased to 170 but dropped to 130 after the patient was placed on bed rest. At this time Lugol's solution (m 2 T.I.D.) was again started and one week later was increased to m 5 T.I.D. Thyroid extract gr. 1½ was given daily until June 9, 1941. During this period the basal metabolic rate dropped to minus 18 and it was noted that the thyroid gland had almost doubled in size and was symmetrical. The patient's weight increased from 43¹₄ pounds on admission to 63 pounds on discharge July 3, 1941, and was apparently in good condition.

On readmission, October 17, 1941, she presented the following symptoms of hyperthyroidism: Exophthalmos with confirmatory

eye signs, soft diffuse thyroid enlargement, pulse 132 at rest, accentuated heart sounds, blood pressure 145/65, marked tremor of

anesthesia was administered by way of an intratracheal catheter and a routine collar-type incision was employed through which both

FIG. 1. Case 1. Preoperative appearance.

FIG. 2. Case 1. Postoperative appearance.

fingers and tongue, and weight 51¾ pounds. Following consultation she was accepted for thyroidectomy and transferred to the surgical service on November 4, 1941. Preoperative preparation consisted of bed rest, high caloric diet, phenobarbital, Lugol's solution (m 10 T.I.D.), vitamin B complex and increased protein intake orally. The basal metabolic rate on November 11th was plus 15. Despite continued therapy the pulse rate remained relatively high (110–130). However, the patient's weight increased five pounds. On December 1st there was definite signs of improvement. The emotionable stability was better and the pulse rate more stable. Although the maximum pulse rate was 130, a tendency toward a slower rate was apparent and she continued to gain weight. The pulse pressure showed no tendency to increase, and iodinization had been adequate. By December 3rd the basal metabolic rate had dropped to plus 9. Cardiac consultation at this time showed evidence of marked toxicity but this was thought not to contraindicate surgery. (Fig. 1.) On the following day, cyclopropane-oxygen

superior poles were ligated with silk. This type of incision was decided upon since it was believed that it would offer a more rapid and thorough means of approach to the problem of ligating the poles in this highly toxic patient. The total elapsed operating time of eleven minutes apparently justified the decision to employ this means of approach.

On return from the operating room the pulse rate was 140–170, of good quality and regular. The child reacted from anesthesia and became restless, which was controlled by paraldehyde given per rectum. The oxygen mask was well tolerated and although the respirations were shallow and thoracic in type there was no evidence of respiratory obstruction or anoxia. Ergotamine ½ cc. was given at 4-hour intervals with Lugol's solution m 15. However, the pulse rate, temperature and respiration continued elevated. The child was motionless, failed to respond to stimuli and the corneal reflexes were absent. A venoclysis of 1,000 cc. of 10 per cent dextrose in saline and 10 cc. of 10 per cent sodium iodide was given. The respirations improved and

the temperature was controlled with ice packs.

On the following morning the patient was given 1,000 cc of 10 per cent dextrose in normal saline and 10 cc. of 10 per cent sodium iodide. Her condition remained unchanged except that she now reacted to stimuli. In the evening a continuation of the present régime resulted in a lightening of the coma although the pulse remained very rapid. The patient was placed in an oxygen tent. On December 6th the patient was much improved, fully conscious, took fluids well by mouth, sat up in bed and ate ice cream and lolly-pops. The pulse rate decreased to 130. Marked improvement continued; she took a soft diet, candy, and fluids; the pulse was steadier and slower. The drain was withdrawn and alternate skin clips removed; the incision was healing well. On December 9th all clips were removed; the wound was healing well, and the patient's general condition was excellent. On December 13th the basal metabolic rate was minus 9. Pulse rate varied between 100 and 130 and the patient's condition was satisfactory for further surgery to be limited to hemithyroidectomy.

Two days later a right hemithyroidectomy was performed. Microscopic examination of tissue showed marked connective tissue proliferation and numerous focal areas of round cell infiltration. Some of the acini presented low papillary projections. The pathological diagnosis was toxic goiter.

The patient's convalescence following this operation was uneventful. Her pulse rate never exceeded 140. The maximum temperature was 102°F. on the first postoperative day. On the following day the pulse was 120 and the temperature 100°F. A striking point was the improvement in the patient's former surly disposition. Her appearance became much less apprehensive. She was apparently happy and had gained seven pounds. This represented a 20 per cent gain in total body weight since her admission to the surgical service, and a net gain of about 12 per cent since her operation three weeks before. The wound healed well except for a small granulating area in the center. Application of a 10 per cent solution of silver nitrate removed the exuberant tissue.

On January 19, 1942, a small fluctuant mass about 2 cm. in diameter was noted to the right of the midline. This was assumed to be a sterile abscess due to silk suture irritation.

Incision and drainage was performed and a culture taken which proved negative for micro-organisms. Drainage subsided following the application of sulfathiazole powder. The patient was discharged on February 25th. Further observation of the patient was continued in the out-patient department.

On April 14th, she was re-admitted exhibiting little evidence of thyrotoxicosis and in good general health. There was only slight tremor, pulse 106, no apparent improvement in the exophthalmos, marked lid-lag, freely moveable scar and several areas of keloid-like scarring. The left thyroid lobe was barely palpable.

A tender fluctuant area about 1 cm. in diameter was noted at the site of the original sterile abscess and on April 23rd this mass was opened under local anesthesia. About 5 cc. of purulent fluid was evacuated along with two pieces of black silk suture material. Despite this procedure the wound continued to drain and two additional pieces of black silk suture were removed on April 29th.

On May 11th, sinus tract drainage continued and a small amount of seropurulent and granulation tissue was removed. On May 14th, débridement, drainage and curetting of the sinus tract was performed under general anesthesia. Despite these operative procedures a persistent sinus reformed with continued seropurulent discharge and exuberant granulations. The sinus was probed and found to extend toward the right superior thyroid pole. Additional black silk suture material was removed.

The patient was discharged to the clinic June 11th with a persistent silk sinus. (Fig. 2.) Her weight on admission was 64½ pounds; blood pressure 96/70. Her weight on discharge was 68½ pounds; blood pressure 105/78. A slight but steady weight gain was noted, and the blood pressure showed little variation.

Continued observation of this patient is being carried out in the endocrine clinic. She has also been examined on repeated occasions at the thyroid committee conference. Despite the complete subsidence of thyrotoxic symptoms, it was the concensus of opinion that further surgery will be necessary because of the probable danger of reactivation of the remaining intact lobe. However, in view of the considerable recent operative trauma, it was decided that further intervention should be

deferred and that conservative measures be continued especially since the patient and family are co-operative and continued observation will be possible.

sinus tachycardia; blood chemistry was normal. After two weeks' observation the child was discharged and referred to the endocrine clinic for follow-up. While under observation
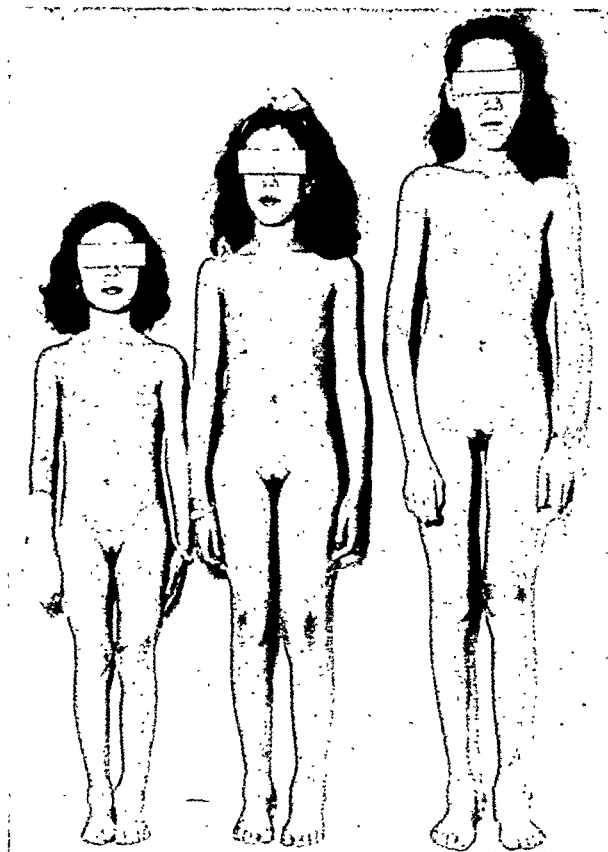
FIG. 3. Case II. Three sisters, ages five and one-half years, seven and one-half years and thirteen and one-half years, respectively.

Five months following operation this patient without further surgery can be considered a normal child. She shows a significant improvement in behavior, has lost her former surly attitude, weighs 74 pounds and presents a marked recession of her original exophthalmos. Basal metabolism at this time is minus 17.

CASE II. A. M. Chart No. 112958. The patient, age six years, was admitted on May 8, 1942, with complaints of tremor, increased excitability, bulging of the eyes, intolerance to heat, and swelling of the neck. She was first admitted October 17, 1941, for a swelling of the neck which was present for three weeks. On this admission there was no evidence of exophthalmos or other symptoms of thyrotoxicosis. There was a diffuse hyperplasia of the thyroid, the heart was not hyperactive, basal metabolism o, electrocardiogram showed

during the six months prior to the present admission there had been a gradual development of toxic signs which became progressively worse, and hospitalization for surgical removal of the thyroid was advised. (Fig. 3.)

The patient was thin, pale, very active and an extremely co-operative female. No abnormalities of the head were noted; pupils were equal and reacted to light and accommodation. There was slight internal deviation of the left eye (Fig. 4); palpebral fissures were widened; marked exophthalmos; lid-lag definite; no wrinkling of the forehead. Ears and nose were normal. The thyroid was enlarged bilaterally (Fig. 5), the right lobe was larger than the left; the isthmus was readily outlined. A thrill was palpable and a bruit was audible over the thyroid. Lung expansion was equal and resonant to percussion; there was vesicular

breathing; the heart rate was 158; blood pressure 150/50; the apex was in the sixth intercostal space in the midclavicular line. Cardiac consultation revealed heart sounds

was there any respiratory difficulty. The oxygen mask was well tolerated. She reacted from anesthesia in normal time and was able to phonate without difficulty. Her temperature
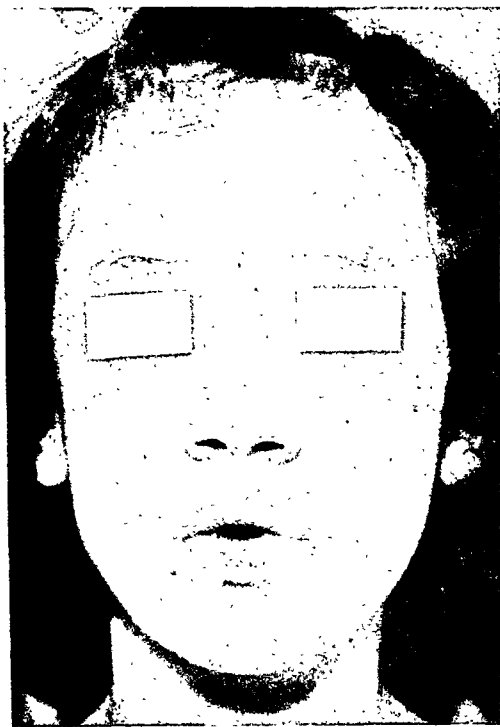
FIG. 4. Case II. Preoperative appearance.

FIG. 5. Case II. Preoperative appearance.

hyperactive; no murmurs were present. The abdomen was soft and symmetrical. Liver and spleen were not palpable. Tremors of the hands were present and all reflexes hyperactive.

Following admission, the patient was examined in endocrine and pediatric consultation. The thyroid was diffusely enlarged with irregular nodules throughout. On a four plus scale, the thyroid was enlarged to two or three plus. It was concluded that the child had diffuse thyrotoxicosis with superimposed toxic adenoma. Surgery was recommended and routine preoperative preparation was instituted. Under this régime the pulse rate ranged between 120 and 140, whereas on admission the pulse rate was over 140. Basal metabolism fell from plus 28, to plus 4; the patient gained weight, the tremor was less pronounced and the general condition improved markedly.

May 28th, after two weeks of preparation, subtotal thyroidectomy was performed through a collar incision. Approximately ⅞ of the left lobe, ¾ of the right lobe and the entire isthmus were removed.

The child was observed every hour during the day following operation and at no time

rose to 103°F., but was readily controlled by alcohol sponge baths. The pulse was maintained at about 116 and respiration 30. On the second postoperative day the temperature was 99.4°F., pulse 140, and respirations 40. On the third postoperative day the temperature rose to 104.4°F. and remained elevated in spite of repeated sponge baths. Postoperative atelectasis or pneumonia of the left base was suspected by the pediatric consultant. X-ray examination did not confirm this opinion. Ice bags were placed on the extremities and head. There was no evidence of respiratory difficulty. The patient continued to receive 90 per cent oxygen by mask. She was able to take small amounts of fluid by mouth, including Lugol's solution. Ergotomine ½ cc. was administered every three hours. The dressing was removed and the wound inspected. Oxygen inhalations were continued. The child continued to become more alert and the pulse was of better quality and slower. Fluids were well taken. Dressings were changed and the drain removed; the wound was clean.

The further postoperative course was entirely satisfactory. It was the opinion of the

endocrine consultant that the patient had suffered a mild postoperative thyroid crisis which apparently was attributable to anoxemia. The surgical service did not completely concur in this opinion. Although conceding that there may have been a mild hyperthyroid crisis, this certainly was not attributable to an anoxemia since at no time had there been any respiratory difficulty and the patient had been continuously receiving 90 per cent oxygen by mask.

The further postoperative course was entirely uneventful; the maximum pulse was 132 with an average pulse of 110 to 120; the temperature was below 100°F., blood pressure 116/58. The wound healed by primary union and the patient was out of bed on the fourth postoperative day and was ambulatory on the fifth day. On the sixth postoperative day the basal metabolism was minus 4. She was discharged on the fourteenth postoperative day and was referred to the endocrine clinic for follow-up. The pathological report was as follows: Proliferation of acini filled with degenerated colloid. Some of the acini show low papillary projection. The connective tissue is increased in amount and there are many areas of small round cell infiltration. *Diagnosis:* Toxic adenoma of the thyroid.

The patient has been closely observed for the past five months. She has gained weight, her pulse averages 80 to 84 and her basal metabolism at present is minus 4. She has shown no tendency toward recurrence of her former toxic state.

REMARKS

The familial aspect of juvenile hyperthyroidism is illustrated by our two cases, which included four members of one family, three sisters and one cousin. Three members presented symptoms of hyperthyroidism and one of benign goiter. Of additional interest is the presence of diabetes mellitus in another sister and also the tendency toward the diabetic state was noted in Case II. This endocrine relationship has been demonstrated by Steener and Newcomb.[2] The sugar tolerance curve (in mg. per cent, fasting 85, ½ hour 145, 1 hour 160, 1½ hours 170, 2 hours 110) in Case II does not appear typical of the thyroid type but is prolonged, apparently tending toward the diabetic variety although the fasting blood sugars are low.

Case I presented the history of exophthalmos at the age of two years. According to the literature, this is a rare finding. Elliott[3] reported the presence of exophthalmic goiter in his case before one year of age as being "a real medical rarity."

We are in accord with the concensus of opinion that the juvenile hyperthyroid case is a definite surgical problem for which prolonged medical therapy should not be undertaken. This is borne out in our experience with the management of our two patients.

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APPENDICULOCOLIC FISTULA

CASE REPORT

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EXPLORATORY operation was performed in the following case because of recurrent, indefinite abdominal pain, and unusual roentgen findings.

of cramps, most often occurring at night, ever since he could remember, never with nausea, vomiting or diarrhea. Severe attacks had been accompanied by mild anorexia. He remembered

FIG. 1. Appearance after barium meal.

C. H., a private soldier, colored, aged twenty-four, had been seen at sick call several times because of abdominal cramps. No positive physical findings were ever noted. He was admitted to the Station Hospital, November 14, 1942, complaining of steady soreness in the right lower quadrant of his abdomen for the past two days, aggravated by stooping, lifting or straining. From November 8th to 12th he had had frequent periods of crampy pain in the right side and peri-umbilical region. He had had similar but less prolonged attacks

vaguely a "long" abdominal illness at about ten years of age.

His past history was negative except for the usual exanthemas and two attacks of gonorrhea. Inventory by systems was all answered in the negative. He used alcohol to excess occasionally and smoked twenty cigarettes daily. He was born in Mississippi but had lived the past two years in Texas.

Physical examination was completely negative, except for complaint of tenderness on deep pressure over the right lower quadrant.

The urine was normal; white blood count was 6,500, polymorphonuclears 70 per cent, lymphocytes, 30 per cent. Wassermann and Kahn reactions were negative. Gastrointestinal

was thought to be the tip of a well filled, upward and medially directed appendix.

Exploratory operation through a right rectus incision was performed under 15 cc. of 1:1500
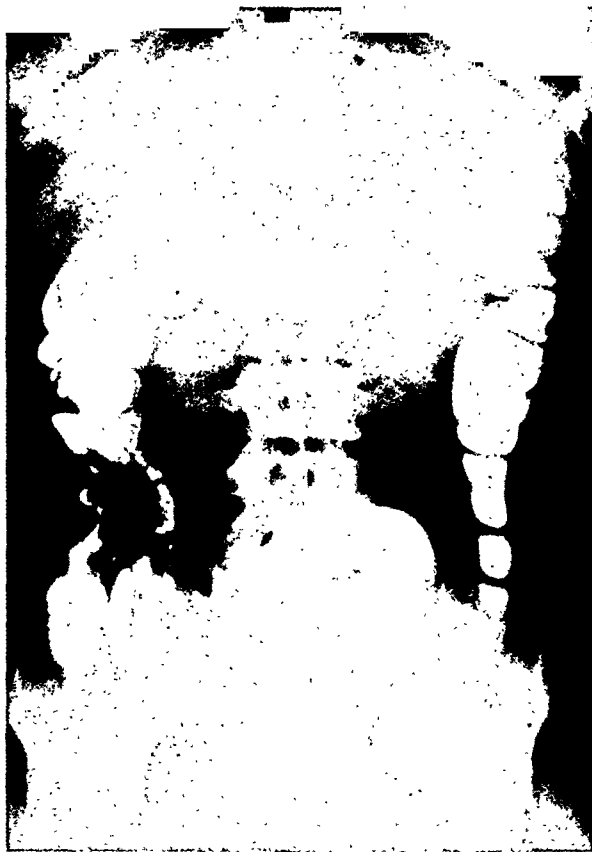
FIG. 2. Appearance with barium enema.

x-ray examination was negative except for continued spasm in the cecal region and the presence of a small residual mottled density at the mesial aspect of the ascending colon slightly above the level of the transverse process of the fifth lumbar vertebra. (Fig. 2.) His soreness disappeared and he was discharged from the hospital November 18, 1942.

After several more appearances at sick call, he was re-admitted December 16, 1942. Physical findings were still negative. A repeat barium meal showed cecal appearance as in Figure 1. Figure 2 shows the appearance with barium enema. Considerable spasm was present, at each examination, in the freely movable cecum, and it was difficult to make it fill well. The small mottled density seen previously appeared to be in the wall of the colon, medial to a constantly unfilled area, and near what

nupercain solution intrathecally, December 19, 1942. A small, movable retroperitoneal mass was felt at the location of the mottled density. The appendix was not seen until the cecum was well mobilized, at which time the appendix was found to extend upward 2.5 cm. from its base (Fig. 3A), and joined a 2.0 cm. wide by 1.5 cm long, rounded mass (Fig. 3B), itself joining the ascending colon 5 cm. above the base of the appendix. The mass was of doughy consistency. The contents were expressed into the colon. From the mesial aspect of this adventitious structure a long, slightly thickened appendix extended downward and laterally toward the tip of the cecum. (Fig. 3C.) (We had mistaken the direction of the appendix.) The distance on the mesial wall on the ascending colon, (Fig. 3D) between the base of the appendix and the attachment of the

fistulous tract was slightly more than 5 cm. No other abnormalities were found.

The appendix stump and colonic end of the fistulous tract were treated, after division

appearance except for the presence of a few eosinophiles. The fistulous tract was lined with mucosa without crypts. No muscular layer was present.
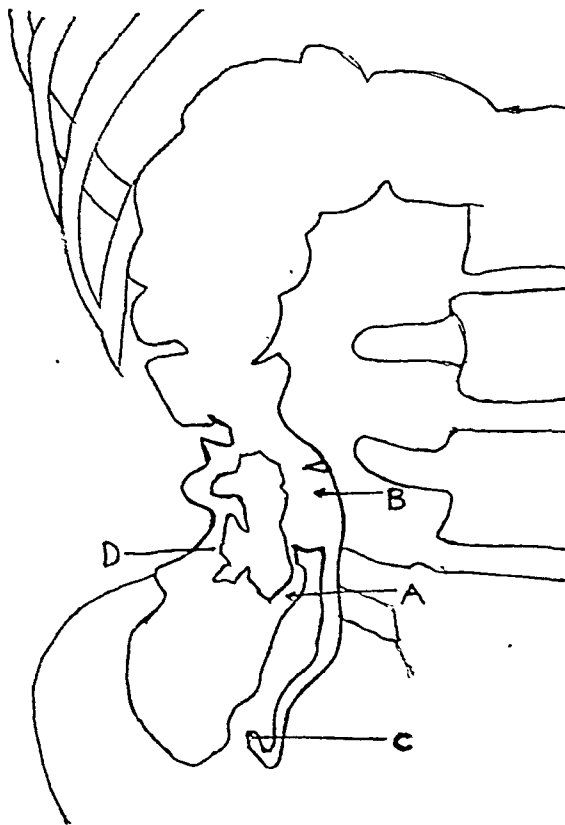
FIG. 3. Diagram of Figure 2. A, base of appendix; B, fistulous tract; C, tip of appendix; D, ascending colon, spastic.

between clamps, by inversion without ligation. The wound was closed in layers with interrupted silk sutures. The patient made an uneventful recovery.

The appendix was 14.5 cm. long, rather sharply angulated 2.5 cm. distal to the divided end at which site a smooth, tubular lateral projection extended 1.2 cm., with a diameter roughly twice that of the appendix. No marked constrictions were noted in the lumen of the appendix. Section of appendix was normal in

SUMMARY

1. A case history is reviewed in which an appendiculocolic fistula is presumed to have been due to intracolic rupture of an appendiceal abscess.

2. The x-ray appearance of cecum and ascending colon indicated persistent spasm of the cecum and slow emptying of the fistulous tract.

ACUTE SPONTANEOUS PERFORATION OF THE GALLBLADDER

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PERFORATIONS of the gallbladder are divided into the acute, subacute and chronic types, depending upon the rapidity of the perforation, and occur in from 1 to 3 per cent of all cases of biliary disease with an average mortality of about 40 per cent.[1] The highest mortality, about 50 per cent,[2] occurs in the acute type, because the gallbladder contents are disseminated freely into the peritoneal cavity. The vast majority of acute perforations are associated with stones and a history of long standing gallbladder disease. The condition is usually diagnosed perforated peptic ulcer, ruptured appendix, high intestinal obstruction or acute cholecystitis, so that the correct preoperative diagnosis is rarely made. The treatment is early operation.

The following case is reported because it presents several interesting and unusual factors:

CASE REPORT

An obese female, age forty-nine, short in stature and weighing 306 pounds, was admitted to the surgical service of the Delaware County Hospital, March 13, 1937, at 11:50 P.M. with severe abdominal pain. For many years she had mild indigestion for which she had never consulted a physician. There was no history of jaundice or colicky pain. While seated in a moving picture theater she was suddenly seized with a severe, sharp pain in the epigastrium, accompanied by nausea and weakness. With assistance she walked to the rest room, where bicarbonate of soda was given and promptly vomited. Because of the continuance of the symptoms, the patient was removed to the hospital one hour later. By this time the pain had extended along the right side of the abdomen into the pelvis and was associated with pain at the tip of the right shoulder. The abdomen was generally rigid and more tender on the right side, but the extreme obesity prevented any definite localization. Her temperature was 97°F., pulse 112, respiration 28, blood pressure 160/90; hemoglobin 65 per cent, red blood cells, 3,780,000, white blood cells 12,900, 74 per cent polymorphonuclears with 25 per cent nonsegmented. Urinalysis was normal. A preoperative diagnosis of perforated peptic ulcer was made and operation performed one hour after admission, using nitrous oxide and ether anesthesia.

On opening the abdomen through an upper right rectus incision a moderate amount of greenish-brown fluid was encountered free in the peritoneal cavity, chiefly on the right side. The stomach and duodenum were negative. There was a large impacted stone in the neck of the gallbladder and just above this there was a perforation about one-half inch in diameter. There was no evidence of acute cholecystitis. The stone was removed through an incision in the fundus, following which the perforation was repaired and the gallbladder drained by means of a rubber tube through the fundus. Two cigarette drains were placed in the gallbladder region and one suprapubically. The maximum temperature and pulse were 101 and 120, respectively, on the second day and remained normal after the fourth day. Bile drained freely through the gallbladder tube, which was removed on the thirteenth day without complications. The cigarette drains were removed on the fifth day. She was discharged on the thirty-fourth day without symptoms. After four years she is still well with the exception of an occasional mild indigestion.

CONCLUSIONS

1. The diagnosis of the acute type of perforation of the gallbladder is difficult and rarely made preoperatively.

2. Its mortality is extremely high.

3. Prophylactic calculus cholecystectomy, thereby reducing the incidence of perforation, is the best way to lower the mortality.

4. Acute perforation of the gallbladder can occur without acute cholecystitis.

5. The treatment is early operation.

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EARLY establishment of external communication of the terminal bowel is indicated in complete atresia of the anal canal or rectum. When stenosis alone is present, dilatation with bougies or the little finger well lubricated suffices. In external fistulous termination of the rectum in the male and vaginal communication in the female, no indication for immediate operative intervention usually exists.

From "Intestinal Obstructions" by Owen H. Wangensteen (Charles C. Thomas).

REMOVAL OF VULVAE AND PERINEAL BODY BECAUSE OF SQUAMOUS CELL EPITHELIOMA

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REMOVAL of the perineal body is seldom necessary but can be done. In this particular case a neglected squamous cell epithelioma, starting along the posterior margin of the vaginal inlet, had deeply invaded the perineal body. The pain, accompanying the ulceration of the growth, rendered sexual intercourse impossible and disturbed the patient night and day until she had become a narcotic addict. Even while using large doses of morphine the patient was in such pain that she could not sit or walk or lie on her back. She rolled in bed, moaning constantly even when sleeping for short intervals. Her general health was disturbed and she was emaciated, having lost nineteen pounds during the past six months.

Consultation resulted in recommendation of removal of the perineal body by means of bipolar high frequency electrocoagulation. Under avertin anesthesia, the posterior two-thirds of both vulvae and the entire perineal body were removed leaving the anterior rectal wall and approximately half of the anterior portion of the anal sphincter. The use of the coagulating electric current avoided all bleeding so no sutures were necessary. No vaginal pack was used and normal saline vaginal irrigations three times daily were begun as soon as the patient recovered from the anesthetic. She slept soundly the night following the operation and has had no pain since. Morphine was entirely withdrawn in ten days and the wound healed by granulation in six weeks. The patient's normal desire for food returned and she regained her normal weight in twelve weeks.

During the second postoperative week the anterior wall of the rectum gave way and she has a rectovaginal fistula so that stools come through the vagina. The patient has learned to regulate her diet so she defecates regularly but wears a perineal pad for safety. She goes about the work of a normal housewife and enjoys an otherwise normal life.

Infiltration of the perineal body is seen only in late cases of malignancy so that the problem of removal is seldom encountered. The vascularity of the parts and the lack of tissue to close the space present a difficult problem, solved, in this particular case, by the use of the coagulating high frequency electric current applied by use of a large indifferent electrode under the patient in contact with the skin and a pointed active electrode to remove the diseased tissue. The wound healed by granulation and completely epidermized without grafts.

In 1940, cancer was responsible for 158,335 deaths—a rate of 120.3 per 100,000 population in the United States. This represents approximately 10 per cent of all deaths. Twenty-five per cent of these deaths were due to neoplasms of the female genitalia. The 36,412 women who died from cancer of the breast and genitalia account for nearly 44 per cent of all cancers in women.

F. J. Taussig[1] reports 155 cases of cancer of the vulvae treated during the years 1911 to 1940. Surgery was used by him in all but thirty-eight cases. During the early part of this period he used radium and x-irradiation but soon abandoned its use because of the unsatisfactory results and painful sequellae. He prefers the removal of both sides of the vulvae and the inguinal nodes by his modified Basset operation in those suitable for such an extensive opera-

tion. In poor operative risks and usually in those patients over sixty-five years of age, he uses electrocoagulation to destroy

FIG. 1. Microphotograph of tissue removed for biopsy showing "overgrowth of differentiated squamous epithelial cells with both coarse and disseminated infiltration and frequent formation of epithelial pearls. Squamous cell carcinoma. Grade 1"—Dr. E. G. Eggers.

the ulcerated mass and allay pain. By employing this technic, he has shown 58.5 per cent five-year cures in clinical grades 1 and 11 even though 41 per cent of this group showed lymph node metastases at the time of operation. The 155 cases reported by Taussig originated from the following parts:

	No. of Cases
Epidermal	104
Vestibular	11
Periurethral	12
Bartholin gland	9
Glans clitoris	2
Unclassified (advanced)	17

Fifty-seven per cent had lymph node metastases. The five-year results of the various types of treatment employed by him are as follows:

	Per Cent
Basset operation and vulvectomy	58.5
Superficial or incomplete node removal and vulvectomy	28.6
Vulvectomy only	8.2
Radiation	4.8
Palliative (no operation or radiation)	0.0

Berven[2] of the Radiumhemmet, Stockholm, reports 177 cases of cancer of the vulvae using the following methods of treatment, with corresponding five-year results:

	Per Cent
Clinical grade 1 no nodes—vulvectomy and radium on nodes	59.3
Clinical grade 11 secondary nodes—vulvectomy and radium on nodes	22.9
Clinical grade 111 inoperable metastases—radium only	3.8

Berven uses electrocoagulation to remove the vulvae instead of the sharp knife, claiming the following advantages: no bleeding during operation, little postoperative pain, less infection, lower postoperative mortality—8.5 per cent—and soft scar.

CASE REPORT

CASE No. 54945. Mrs. Wm. E., twenty-seven years of age referred by Dr. Louis Moon, stated that six months previously she went to a physician because of pain at the inlet of the vagina. On the diagnosis of cancer, repeated radium treatments were given in the office. In spite of the treatment the pain increased and the tumor grew larger until she could scarcely

walk or sit and had to lie face down to sleep. Large doses of morphine were necessary to control the pain.

granulation in six weeks, covering over with epithelium. The anterior rectal mucosa gave way during the second postoperative week re-

FIG. 2. Photograph of vulvae and perineum at present time showing complete epidermization and slight prolapse of the rectal mucosa into the vaginal canal.

Physical examination revealed an ulcerated, indurated new growth involving the posterior one-third of both vulvae and the fourchette, accompanied by extension deep into the perineal body. Small nodes were palpable in both inguinal regions. Otherwise the examination was negative.

Tissue removed by Dr. Moon for biopsy showed squamous cell epithelioma.

Under avertin-ether anesthesia the posterior two-thirds of both vulvae, the entire perineal body and anterior rectal wall down to the mucosa and the anterior half of the anal sphincter were removed by electrocoagulation. There was no bleeding during operation, no postoperative pain and the wound healed by

sulting in a fistula with moderate prolapse of the rectal wall. Outside of this difficulty an uneventful recovery was made. Postoperative high voltage x-irradiation was given over each inguinal region using the following factors: 200 K.V., Thoraeus A filter, 50 cm. distance, 200 r daily, total dose 1,600 r each area.

The patient was well and showed no evidence of recurrence or metastasis two years and eight months after the operation.

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PRIAPISM*

CASE REPORT AND REVIEW OF THE LITERATURE

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TRUE priapism is a persistent painful penile erection usually unaccompanied by sexual desire. It is a rather rare pathological condition although the underlying disease processes of which it is a symptom are not uncommon.

Hinman[11] reviewed the literature in 1914 and reported 170 cases. His has been the most extensive review of priapism. In 1923, Planer and Kutzman[17] reported one case of their own and added thirteen from the literature. McKay and Colston[14] added three of their own in 1928 and collected nineteen from the literature. Since McKay and Colston's report thirty-seven additional cases have been reported in the English and American literature, mostly case reports. No doubt many more cases have occurred than have been reported as the disease processes causing priapism are not uncommon. It has been stated by Dawson[8] that fully 25 per cent of all leukemia cases are accompanied by priapism.

Etiology. There are many different etiological factors involved in the development of priapism. Hinman's suggested classification is the most widely accepted: (1) *Cases resulting from nervous causes:* (a) From ascending peripheral stimuli (reflex) such as inflammation, infection or tumors of the urethra; (b) from direct stimuli to the spinal cord center or to the nervous system; (c) From descending cerebral stimuli, direct and indirect, traumatic, neoplastic, inflammatory, or functional disease of brain or spinal cord. (2) *Cases resulting from local mechanical causes:* (a) Hemorrhage and hematoma; (b) thrombosis and pseudothrombosis; (c) new growths, and (d) inflammatory swelling and edema.

However, it is difficult to see just where some of the diseases known to cause priapism would fit into Hinman's classification. As Barney[1] has stated in his care of priapism as the initial symptom of splenic leukemia, "whether it is a thombis from excessive myelocytes or a thrombis of the ordinary sort I do not know." Further priapism occurs as a result of metastatic malignancies such as the case of Craig[3] in which hypernephroma metastases occurred to the corpus cavernosum. While this could be classified as a mechanical cause, the underlying process is fairly remote. Also a more recent etiological factor has been reported by Finkler[9] who had a case of seventeen days' duration following treatment of a eunuch with testostrone proprionate.

It is suggested that a simpler etiologic and anatomic classification would be:

A. Primary causes of priapism
1. Post urethritis
2. Local malignancies
3. Bladder stone. Hinman mentions priapism as a frequent symptom of bladder stone in children.

B. Secondary causes of priapism
1. Leukemia. Brown and Diog[4] report a case in which priapism was the first symptom of myeloid leukemia in an otherwise healthy laborer.
2. Multiple sclerosis. Wilgus and Fells[19] reported a case of priapism as the early symptoms of this disease.
3. Central nervous system syphilis. Hinman reports priapism in a newborn congenital syphilitic.
4. Cord injuries and inflammation
5. Cerebral hemorrhage
6. Neurasthenia. This has been well described by Huhner[12] and Oberndorff.[15]
7. Male sex hormone injections are reported by Finkler.[9]

8. Sickle cell anemia as reported by Dawson.[8]

Pathology. The pathological reaction of priapism consists of the distention of the venous sinuses of the corpus cavernosa, usually the corpus spongiosum and glans are not involved. Colston and McKay[14] state that thrombosis occurs if the priapism exists more than two days and believe that regardless of the cause the priapism should be treated by some method that will remove the thrombis. Huhner[12] states that his experience does not bear this out. In his cases and in others cure has been effected without attacking the corpus cavernosa.

The blood in the corpus cavernosa in priapism is black, thick and stringy. There is usually a clonic contracture of the ischiocavernous and the bulbocavernous muscle.

Treatment. There are diverse forms of treatment suggested. Normally, the underlying cause should be treated. However, a persistent priapism, regardless of the cause is not only painful and leads to urinary retention but is also dangerous. Dawson reports a case of a patient who expired with gangrene of the penis. Therefore, a priapism of prolonged duration requires immediate attention.

The forms of treatment suggested are: (1) If the erection is sustained by the presence of a local malignant growth, radical amputation and resection of the inguinal glands is recommended. (2) Ligation of the dorsal arteries of the penis—close to the pubis. (3) Division of the ischiocavernous muscle. (4) Irrigation of the corpus cavernosa by the use of large aspirating needles and saline as suggested by Colston and McKay.[14] (5) Incision and drainage of the corpus cavernosa. (6) Epidural injection as recommended by Huhner.[12] (7) Ethyl chloride spray to the perineum as recommended by Nagel. (8) Intravenous 1 per cent mercurochrome has been used by Van Duzen. (9) Sedatives and ice bag; spinal and general anesthesia.

The following case is of interest because of (1) the multiplicity of methods of treatment used; (2) because no underlying cause could be found; (3) because of the successful outcome with complete functional recovery.

P. I. S. J., a seventeen year old colored laborer, was admitted to the hospital on April 24, 1942, complaining of a painful penile erection of six weeks' duration. For two weeks prior to the development of the condition he had been guilty of sexual excesses consisting of intercourse two or three times daily. The condition came on quite suddenly while sitting at home. He attempted to reduce it by frequent masturbation and intercourse without avail and three days after the onset he visited his physician. Sedatives and an ice bag to the perineum were used without avail and one week after the development he entered a State Hospital where pudendal nerve block was tried without results. He returned home after one week's hospitalization. At that time the condition was so painful that it was necessary for him to stay in bed; he could not void and catheterization was necessary. He was admitted to the hospital as a bed patient with his bladder distended to the umbilicus.

Physical examination showed a well developed and well nourished colored male; temperature 100°F., pulse 98, respiration 22. Physical examination was negative except for genitalia. The penis was in firm erection and lay back over abdomen. The base of the penis was stoney hard, the bladder was distended to the umbilicus. Blood count was as follows: white blood cells, 10,000; red blood cells, 4,250,000, hemoglobin 80, differential: polymorphonuclears 80 per cent, lymphocytes 19, monocytes 1. Urinalysis: specific gravity 1020, reaction acid, albumin and sugar negative. Microscopic examination: There were occasional pus cells. The blood Wassermann test was negative; the spinal fluid Wassermann was negative. Three cells; Pandy reaction negative. X-ray of bladder and pelvis was also negative.

During the first twenty-four hours after his admission to the hospital he was treated with ice bags to the perineum and morphine without change. In succession following this narcosis by intravenous pentothal sodium, spinal anesthetic and ether anesthesia were tried over a period of two days without change. On the fourth day after admission under pentothal sodium anesthesia two large No. 16 needles were inserted into the corpus cavernosa on

both sides and through and through, and irrigation with normal saline was accomplished. A large quantity of thick black stringy blood was washed out and immediately the penis became soft and pliable. Within four hours the patient was able to void spontaneously. However, about eight hours following this procedure the penis was markedly swollen and as hard as upon admission. On the following day under ether anesthesia the corpus cavernosa was opened on either side by a one-half inch incision. Much old, stringy, black blood was evacuated. The forefinger was pushed as far below and above as could be done in the corpus cavernosa. A gauze pack was placed in both sides and no closure of the skin made. The penis was soft immediately after this procedure. The patient voided freely after recovery from the anesthetic.

The gauze packing was removed in forty-eight hours. The wounds healed in seven days and the patient was discharged in good condition. He was seen six weeks later at which time there was no deformity of the penis and he reported that he was having normal erections two days after he returned home.

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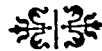
PEDUNCULATED FIBROMYOMA OF THE INGUINO-ABDOMINAL REGION*

CASE REPORT

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FIBROMYOMAS may be found in any organ of the body which contains both smooth muscle fibers and connective tissue. Consequently, this type of a tumor must be considered in the differential diagnosis whenever a neoplasm is encountered in an organ containing both of these tissues. The most frequent site of occurrence of this type of a growth is from the uterine body itself with the remaining structures of the female genital tract being of secondary importance as to the point of origin of these tumors.

Taussig,[1] in reviewing the literature up to 1914, reports a total of 141 round ligament tumors, eighty of which had been previously reported by Emanuel. In 135 of this group the nature of the tumor was stated, seventy-nine belonging to the group of fibromyoma, including fibromas and adenomatous types of tumors in this classification.

In Taussig's group eighteen were reported as intra-abdominal and thirty extra-abdominal; while in Emanuel's series sixty were reported as being in the inguinal canal or labial folds, making a total of ninety extra-abdominal tumors. The type of tumor found in these different locations is not mentioned.

The age group in both was between thirty to fifty years; the majority occurred on the right side and were most frequently mistaken for hernia.

Horine[2] reviewed the literature from 1914 to 1933 and reported a total of thirty-six round ligament tumors, five of which were classified as fibromyomas. Here again, their exact location was not stated, but the age group and site of location corresponded with the résumé as presented by Taussig.

In reviewing the literature to date I am unable to find a report of pedunculated fibromyoma occurring in the inguino-abdominal region with pedicle passing into the inguinal canal.

CASE REPORT

The patient, a female, was forty-eight years of age. The history and physical examinations were entirely irrelevant except for the presence of a lump in the left inguinal area which the patient stated moved around rather freely. It was first noticed about six months before the patient sought surgical relief.

Upon examination a mass, the size of a small walnut, was palpable in the left inguino-abdominal area above the region of the external ring. The ring could be palpated without difficulty and there was no impulse on coughing. The mass was well encapsulated and the outstanding clinical finding was the extreme mobility of the tumor within certain limits.

The preoperative diagnosis was not established and under local infiltrating anesthesia the tumor was removed by dissecting it free from the surrounding tissues and ligating the pedicle which entered the external inguinal ring. (Fig. 1.)

Fibromyomas of the inguino-abdominal region are among the rarest tumors found in this area. Grossly these tumors are hard and of a white, glistening appearance. They are well encapsulated and when incised allow the capsule to retract with a resulting projection of the tumor contents above the surface. The interior of the tumor has the typical whorl-like appearance characteristic of the fibroid group of

tumors. (Fig. 2.) The microscopic pictures (Figs. 3 and 4) show the interlacing muscle fibers, some cut transversely and some cut

certain limits. The mobility can be referred to as the so-called slip-away feel which is descriptively applied to fibro-adenoma of

FIG. 1. Tumor and pedicle.
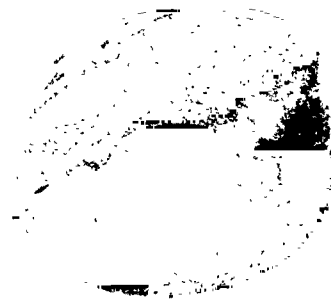
FIG. 2. Showing glistening, pearly white tumor with characteristic whorls. The eversion of tumor contents after incising the capsule is also noted.

FIG. 3. Showing interlacing muscle fibers, some cut transversely and some longitudinally, with the presence of varying amounts of connective tissue. X 37.
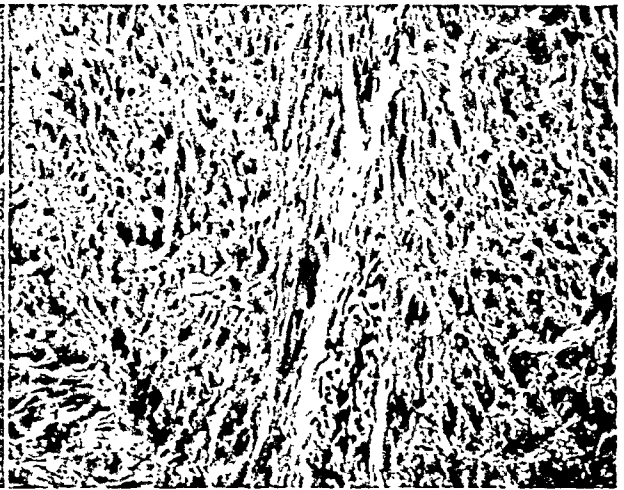
FIG. 4. Same section as Figure 3. X 200.

longitudinally with the presence of varying amount of connective tissue.

If the possibility of the presence of this type of tumor is kept in mind a correct preoperative diagnosis can be made. The tumor is hard and well defined; but the most striking clinical finding is the extreme mobility of the neoplasm within

the breast and is absent in any other type of neoplasm found in the inguino-abdominal region.

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SOVIET MEDICINE

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RADIO Moscow reported the Russian Army advancing on six fronts, the capture of dozens of towns and villages almost every day, the annihilation of the remnants of the German divisions caught in the pocket at Stalingrad, and the rehabilitation of village after village wrested from Nazi hands. And Radio Moscow also reports that, on the heels of the Red Army, come special medical squads of the People's Commissariat of Health Protection to eliminate one of the aftermaths of the Hitlerite "new order": epidemics, chiefly typhus. These medical groups consisted of 1,740 doctors and 5,000 nurses sent to the liberated towns and villages.

Supplied with the necessary medicines and instruments, they are sent to give aid in many villages of the Rzhev District and the Orel Region. There retreating Germans, flinging hand-grenades into basements where women and children had hidden during the fighting, had inflicted a large variety of wounds which made it imperative for Soviet surgeons to perform complex operations on the spot.

After rendering medical aid to the liberated population and trying to restore health to children in a state of complete physical collapse as a result of prolonged starvation, the squads proceed to restore medical institutions destroyed by the Germans. Latest statistics show that the Russian Government has spent 8,000,000 rubles, opened 211 hospitals and eighty-seven nurseries, forty-one children's health centers, 242 anti-epidemic centers and fifteen maternity homes in the liberated districts of the Kalinin, Kursh, Voronezh, Orel and Smolensk Regions. Squads have left for liberated districts in the Stalingrad and Velikie Luki areas to render aid to the population.

Naturally, the medical arm of the Red Army has learned a great deal during the nineteen months since the Nazis attacked the Soviet Union on June 21, 1941. In the words of Dr. Nikolai Burdenko, member of the Academy of Sciences of the U.S.S.R. and Chief Surgeon of the Red Army, particular attention was paid, in organizing the war medical service, to the organization of the American army by studying thoroughly the official reports and articles in different journals.

"We are familiar with such names as Finney, William, Mayo, Peck, Cushing, Goldwhite, Young, Blair, etc.," said Dr. Burdenko. "Modern surgeons such as Roman, Torek, Grotty and Olby are well known to us. The chief military medical administration of the Red Army concentrated its attention on the medical service of the American army, as this corresponds more nearly to the suggestions of the government and to the attitude of scientific circles.

"The aims of our military medical administration were the following:

1—Wartime surgery should be based on the achievements of modern science theoretically as well as practically.

2—Wartime surgery should be carried on by competent physicians.

3—The organization of military medical service of the military field of surgery in particular should have an inexhaustible supply of materials, such as drugs, bacterial preparations, equipment, instruments and x-ray apparatus.

4—Special attention should be paid to the health of the army personnel, primarily to preventive inoculations.

"With these principles in mind, the military medical service was organized as follows:

1—The specialization principle has been followed with regard to surgery, as well as to therapeutic and health hygiene.

2—Much care has been given to the instructions of specialists in major abdominal surgery, traumatology, mandibular facial surgery, neurosurgery, roentgenology, internal diseases and sanitary epidemic infections.

3—All outstanding authoritative physicians of the country have been mobilized to serve as chief surgeons in the army and at the front.

4—The chief military medical administration of the Red Army disposes of a sufficient number of military schools to meet the requirements in medical personnel.

"Great experience has been gained from the severe battles against the foe, resulting in correctives in the organization of the military medical service. Thus the problems of blood transfusions were revised by supplying the army with medicines, bacterial preparations, instruments, etc. A study was made of toxoids, bacteriostatic and sulfonamide preparations, etc."

At present, the number of surgeons exceeds the total number of physicians in Czarist army. At the front, physicians and the whole medical personnel work shoulder to shoulder with the army men. A few months ago, a 70 per cent return of the wounded to the front was reported, and at the present time, this is bettered in many places by the return of even 80 and in instances 90 per cent of the wounded.

Naturally, there have been outstanding cases of individual heroism of surgeons and physicians during the past nineteen months. Last July, Professor Alexander Vishnevski, who had performed over 400 difficult operations in field hospitals, was completing one operation on an officer, wounded in the leg, when the patient was struck by a machine gun bullet from an enemy plane. Vishnevski proceeded immediately to extract the machine gun bullet and saved the officer's life.

Once this same professor drew blood from his own veins during an operation to give a transfusion to a small girl injured when an air raid shelter was blown in by a direct hit.

Surgeon Spasski, in another section of the front, was operating on a Red Army man for a hip wound when the patient complained of a severe pain and a feeling of heaviness in the wound. The surgeon discovered an unexploded 37 millimeter anti-tank shell imbedded in the flesh and successfully extracted it.

Since head wounds are particularly serious, it is interesting to note that Professor N. I. Propper-Grashchenkov, head of the Nervous Diseases Clinic of the All-Union Institute of Experimental Medicine, reports that out of ninety patients operated upon in his clinic between December 25, 1941, and March 25, 1942, the majority recovered.

"Many cases of recovery from really serious brain wounds that would formerly have been regarded as hopeless can be cited," explained Professor Propper-Grashchenkov. "In the case of Senior Lieutenant Perfiliev, wounded in the head during a raid on the staff headquarters of a German regiment of rapid-fire gunners, a bullet from an automatic fire-arm entered his head at the nape of his neck, passed straight through the entire left cerebral hemisphere and lodged in the left frontal region of the brain.

"On x-raying him in the clinic, we found the exact location of the bullet; the patient complained of splitting headaches, evidently due to the fact that some hair and perhaps also a piece of his hat, had been carried into the brain by the bullet. To remove the bullet by way of the opening it had made when entering the skull would have been practically impossible without cutting away a considerable portion of the

brain and thereby causing the patient to lose his power of speech, since the bullet had passed close to the speech centers in the left cerebral hemisphere.

"We resorted to trepanning. By making a small opening in the left frontal bone of the skull, we succeeded in removing the bullet, together with all foreign matter carried along. Lieutenant Perfiliev recovered rapidly."

The necessity for blood transfusions on the firing line has of course led to many improvements in this department of medicine. Army nurses carry trench packets for emergency cases, where there is no time for heating, shaking and the other manipulations that go with the application of the preserved blood of donors. These packets contain a Professor Seltsovky ampule which is provided with a sterilized rubber tube, needle and filter and is filled with blood of the so-called zero group. Thus the nurse can give the transfusion under enemy fire.

Another big achievement is the antishock liquid evolved by the same Professor. The action of this preparation was tested in the treatment of 1,000 cases of acute shock and in all of them it raised the blood pressure. The Learned Medical Council of the People's Commissariat of Health of the U.S.S.R. has permitted large-scale application of the antishock liquid in the Red Army medical service.

War brings with it all sorts of complications, for certainly the surgeons are not always on hand when men are wounded. Soviet surgeons have evolved a method of applying "white streptocide" which delays the spread of infection for twenty-four to forty-eight hours, thus gaining time for the surgeon. Professor Kupriyanov, chief surgeon of the Leningrad Front Area, reports that balsamic bandages on wounds have been effectively applied on the field.

"While in the first World War gangrene affected from 15 to 20 per cent of the wounded in various armies," said Dr. Kupriyanov, "and under certain circumstances even 60 to 70 per cent, early surgical treatment of wounds by methods preventing the spread of infection has limited the incidence of gas gangrene to only 1½ per cent of the total cases in the hospitals of Leningrad.

"Tetanus, the scourge of armies in past wars, does not threaten the Red Army, thanks to the routine application of anti-tetanus measures."

No less instructive are the experiences of physicians serving with the guerrilla fighters, physicians who must operate in the dark with no light except a torch with a weak battery, who must give blood transfusions under difficult circumstances, who must make up their minds quickly in the face of emergency with no one to consult.

Such a doctor is Alexander F., straight out of university medical school. On January 13, 1943, this young doctor wrote: "In my work I firmly adhered to the principles of medicine. When the war is over and the Nazis are finally destroyed, I shall go back to the clinics of my teachers, Stalin Prize Winner Spaskukotsky and Professor Rufano, and say: 'Thank you. You taught me a lot, but I have much more to learn.'"

Editorial

WAR ORGANIZATION OF PLASTIC SURGERY*

IN the overnight conversion of a peaceful nation's medical organization to a military basis, certain mistakes are inevitable. In justice to the men in the armed forces, however, they must be speedily corrected, even when this entails departure from old habits and points of view.

We cannot afford slavish adherence to old routines or a complacent wait-and-see attitude. Failure to make the best possible use of our medical resources will mean deformity, disfigurement and disability to thousands upon thousands of young men who might otherwise be restored to normal life.

In the field of reparative surgery it would be highly desirable to follow the example of leading civilian hospitals and recognize plastic surgery as a distinct specialty. Only in this way can we ensure the early application of correct plastic principles.

The creation of maxillofacial centers to handle reparative surgery in the last war was a natural development of the conditions which prevailed then. Although plastic surgery was not unknown, it was not a distinct specialty and there were neither established plastic services nor surgeons working exclusively in that field. Under those circumstances, military medical units were unprepared to deal with the preponderance of injuries of the

face and mandible resulting from trench warfare.

After two years of mounting casualties of this nature, Lane and Gillies in England, and Morestin, Sebileau and Lemaitre in France, officially organized maxillofacial centers to handle them.[1] At that time it was logical to place this work mostly in the hands of otorhinolaryngologists, working in conjunction with prosthetic oral surgeons since there were no trained specialists in plastic surgery.

Although the creation of maxillofacial centers was a distinct advance, it was never a completely satisfactory arrangement. For one thing there was no provision for early treatment designed to prevent deformity and loss of function. Emphasis on late care, plus a dearth of qualified plastic surgeons, greatly protracted treatment and often failed to produce an acceptable cosmetic and functional result.

Blair made pertinent comment on the results of early versus late treatment in an address before the Southern Surgical Association in December, 1940.[2] Reviewing 340 late burn cases treated in his service during the twenty years following the Armistice, he remarked: "The average time that had elapsed between injury and

[1] GILLIES, H. D. Plastic Surgery of the Face. Preface. Oxford University Press, 1920.

[2] BLAIR, V. P. The role of the plastic surgeon in the care of war injuries. Ann. Surg., June, 1941.

* Read before the Annual Session of the American Society of Plastic Reconstructive Surgery, Baltimore, December 11, 1942.

inauguration of surgical repair was 5.1 years. The aggregate period of disability . . . from the time of injury until final discharge was 2,312 years or an average of 6.8 years for each case. From our experience of the earlier care of deep burns of similar extent," he continued, "it seems fair to assume that with more constructive treatment the great majority of the above 340 cases could have been successfully restored to approximately normal function and acceptable appearance within three months from the time of injury, with half the number of repair operations and very much better average results than was possible with these late-treated cases. Reducing the average disability period for each of the above treated cases from 6.8 years to the estimated average of three months per properly early-treated cases would reduce the total disability period of the whole group from 2,312 years to 82 years." This is extremely significant in view of the great number of extensive burns produced by modern weapons of war.

Blair, who headed the Maxillo-facial Section of the United States Army in the last war and who, with John Staige Davis, Ferris Smith, Robert Ivy and a few others, is largely responsible for the development of plastic surgery in this country, was quick to perceive that the conditions which dictated the creation of a maxillo-facial division in the last war no longer exist to the same extent. As he observed in the address already referred to, unless trench warfare returns, faciomaxillary surgery will not attain the prominence it acquired in the last war and should give way to general plastic surgery. In his own words, "Many of the same type of surgeons as those who responded to the call for Facio-maxillary Units have, in civilian practice developed special skill for working in every part of the body, and in war surgery these could be just as economically and humanely valuable as in civil practice."

John Staige Davis was one of the first to recognize the need for a Division of Plastic Surgery in the Army to care for all casualties requiring plastic repair.[3] Even in the last war he urged that the Facio-maxillary Section be expanded to include all cases in need of plastic reconstruction; but, as he stated before the Southern Surgical Association in December, 1940, he could not "put it over, as there was no appreciation of the necessity of general plastic surgery by those with the power to act." Like others, including myself, he again urged this step in the current emergency, but so far without success.

It is true that short courses in plastic surgery are being given to Army medical men at a few medical schools. The Manual of Maxillo-facial Surgery, so ably prepared by Ivy and Smith, will also contribute to better treatment of facial injuries. But these measures are not sufficient.

While the heads of general hospitals are authorized to assign reconstructive cases to a plastic surgeon if they see fit, they are not required to do so. It is left to their option whether to organize a service for plastic cases or do this work themselves.

It is no reflection on the skill of the general surgeons to say that few of them are equipped by training or temperament for plastic surgery which, in Blair's words, requires a "different mental make-up than . . . work in problems related to the special sense or the vital organs." As far back as 1926, Davis remarked that "it is a well-recognized fact that few general surgeons can do plastic work well. . . . "[3] The interests of these patients are better served when treatment is given by trained specialists than when they are looked after by the general surgical service.

With others familiar through actual military experience with the type of casualties we can expect to encounter, I believe that the Maxillo-facial Division should be expanded into a Division of Plastic Surgery, empowered to handle all injuries requiring plastic repair, whether located on the face and jaws, neck, trunk, or extremities.[4] The

[3] DAVIS, J. S. The story of plastic surgery. *Ann. Surg.*, June, 1941.
[4] MALINIAC, J. W. *Plastic surgery in war. Tr. Ninth Ann. Meet. Am. Soc. Plastic & Reconstructive Surgery*, Chicago, October 25, 1940.

boundaries of plastic surgery are clearly set forth in Davis' definition: "Plastic surgery is that branch of general surgery which is distinctly formative or restorative. It deals with the reconstruction of injured, deformed or lost parts all over the body; with the re-establishment of function, and incidentally with the improvement of appearance."

A Division of Plastic Surgery must envisage three stages of treatment: early, intermediate, and late.

Even in the early treatment, given at front medical posts, where the saving of life is the first consideration, certain basic principles of plastic repair must be applied to prevent deformity and shorten the period of repair. The emergency measures taken in large burns and jaw fractures, to cite two types of wounds, may determine the course and final outcome of reconstruction. The front line surgeon should, therefore, have some knowledge of the fundamentals of plastic repair.

The second or intermediate stage of treament devolves mainly upon base and general hospitals. Here, infections are treated, tissue losses provisionally replaced, fractures of the mandible reduced and temporary prosthetic work done, with a view to preservation of function. Well organized subdivisions of plastic surgery, with qualified specialists in attendance, are indispensable at these hospitals.

For the long, final stages of repair, patients requiring extensive plastic reconstruction must be segregated in special plastic centers, headed by a general plastic surgeon.

The creation of a Division of Plastic Surgery on the scale envisaged would require the fullest possible utilization of qualified personnel in this field. This may make necessary the abrogation of present age limits. In medicine, experience contributes more to skill and judgment than in almost any other field. Many plastic surgeons who could do valuable work are prevented by prevailing age limits from placing their knowledge and ability at the country's service.

This numerical factor is particularly important in view of the many far-flung fronts in the present conflict. In the last war, we had a relatively short front in which available personnel could be concentrated. Today, our fronts extend over thousands of miles, necessitating a dispersal of medical facilities. Since the supply is necessarily limited, it is essential to call upon and utilize fully all qualified men.

I realize the enormous tasks which war has laid upon the military medical services and the difficulties which attend their current unprecedented expansion. Nevertheless, in view of the number of casualties which will require plastic reconstruction, I believe the organized plastic surgeons of the country, who are familiar with the problems involved, could render a great service by attempting to secure the establishment of an independent Division of Plastic Surgery, with status equal to the other surgical specialties, and to seek fuller utilization of qualified specialists in this field, regardless of age or other arbitrary limitations.

The experience of the last war, the development of plastic surgery since, the favorable experience with separate services for plastic surgery in most of the important civilian hospitals in the past two decades, the existence of a national qualifying board, all make possible a more efficient and comprehensive organization in this field than was possible in the last war, when none of these factors existed.

Sooner or later the indicated reforms will probably come. The sooner the better for the thousands of casualties who will need such service!

This situation is at once a challenge and an opportunity for the leaders in this field. The great bulk of casualties which may be expected have yet to arrive. There is still time to perfect a suitable system, but time is running short. Let us not be "too little and too late" with the proper organization to care for our wounded and return them as speedily as possible to normal peace time life.

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Original Articles

TRAUMATIC RUPTURE OF THE KIDNEY

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THE run of the mill injuries of the urinary tract often are quite symptomless and obscure when the seriously injured patient is first seen at the site of accident or on admission to the hospital. Urgent and more commanding symptoms of other accompanying injuries tend to divert one's attention from the more silent symptoms or signs of kidney, bladder or urethral injuries. Thus precious hours are often lost in directing treatment to the injuries of the urinary tract. Routine inspection of the urine in all accident cases, noting the presence or absence of blood, will usually prevent such disaster, for with few exceptions hematuria is present in injuries of the urinary tract. Without such routine examination, a comatose patient with skull fracture may die from unsuspected renal hemorrhage, or the patient with a fractured pelvis may go for many hours or days before rupture of the bladder or urethra is discovered.

Less frequently, serious kidney injuries are caused by quite insignificant trauma. In one instance, a fall from a golf bunker on the seventh hole caused the patient such little discomfort that he proceeded with the eighth and ninth holes. On reaching the club house, he noticed bloody urine. This patient had a seriously ruptured kidney. After hematuria has directed one's attention to the urinary tract, its origin is not difficult to determine. If and when the patient's condition warrants a more complete diagnosis, such procedures as x-ray, intravenous urography and cystoscopy may be carried out.

Uncomplicated rupture of the kidney of such severity that operation is considered is seen relatively infrequently and, therefore, no one surgeon sees a large number. A small group of seven patients seen by the author in the past two years, six of whom were operated upon, serve as a nucleus for study in preparing this report. Several other patients seen in earlier years are referred to in the text because of their interest, but are not included in the statistical outline. (Table I.)

Mechanism of Injuries. The normal kidney may be ruptured by force exerted either from the front, side or back, by a blow, fall or crushing force. The degree of kidney damage bears no direct relationship to the degree of force applied but depends more on the way the force is applied and the position and condition of the kidney at the time. If the kidney has previously been decapsulated by operation, damage is relatively more severe than if the protective, fibrous capsule is present. In the presence of congenital renal abnormalities, rupture may occur more readily, notably in polycystic kidney disease. Rupture of a polycystic kidney occurred in one patient as a result of being struck in the side by a stream of water from a fire hose. Spontaneous perinephritic hematuria occurred in one patient due to rupture of an infarct associated with chronic glomerulonephritis. The force may act either directly on the kidney through the intact abdominal wall, or the kidney may be caught between the lower ribs in front and the resistant spine behind. With the kidney normally engorged with blood at the time of injury, the sudden, increased hydraulic pressure causes a bursting of the kidney. It is difficult to rupture a kidney postmortem when the kidney is devoid of blood.

TABLE I

BRIEF SUMMARY OF SEVEN SEVERELY RUPTURED KIDNEYS—NO DEATHS

No.	Age	Sex	Side	Cause	Previous Disease or Anomaly	Associated Injury	Hematuria	Urinary Extravasation	Perirenal Hematoma	Type of Kidney Injury	Operations after Injury	Operation	Postoperative Hospital Days	Complications
1	40	M.	Rt.	Horse kick	0	0	Massive	Yes	Large	Multiple complete fractures	2	Drainage	56	Persistent fistula healed 56 days postoperatively
2	15	M.	Lt.	Horse kick	0	0	Slight	Yes	Moderate	Multiple complete fractures	2	Nephrectomy	12	0
3	19	M.	Rt.	Horse kick	Bilateral double pelves and ureters	0	Moderate	Yes	Moderate	Single complete fracture	2	Drainage	12	0
4	11	M.	Lt.	Coasting	0	Ruptured spleen	Massive	Yes	Small	Multiple complete fractures	1	Kidney exploration and drainage Splenectomy	16	0
5	16	M.	Lt.	Merry go round	0	0	Moderate	Yes	Large	Single complete fracture	2	Nephrectomy	17	Pedicle hemorrhage; clamps left
6	18	M.	Lt.	Football	0	0	Moderate	?	Moderate	Nearly complete decapsulation by subcapsular hematoma	4	Decapsulation complete and drainage	10	0
7	38	M.	Rt.	Golf	0	0	Massive	No	Large	Questionable	0	No operation. Home 7 days after injury	..	0
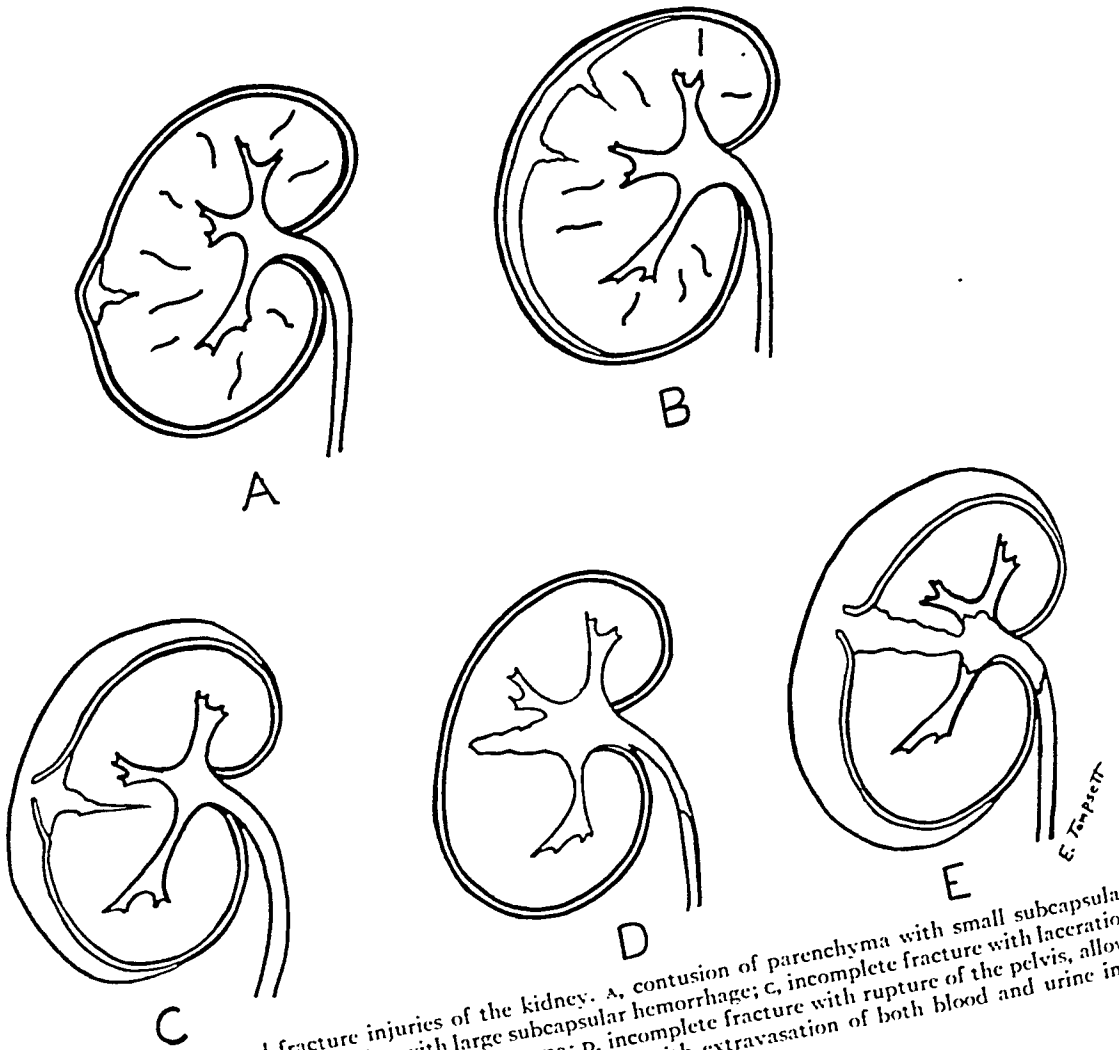
FIG. 1. Contused and fracture injuries of the kidney. A, contusion of parenchyma with small subcapsular hemorrhage; B, severe contusion with large subcapsular hemorrhage; C, incomplete fracture with laceration of the capsule and large perinephritic hematoma; D, incomplete fracture with rupture of the pelvis, allowing the pelvis to fill with blood; E, complete fracture with extravasation of both blood and urine into perinephritic tissue.

Classification. The appearance of the kidney at operation or autopsy depends upon the extent of injury. All renal injuries should fall into one of the three main divisions in the following, simple, practical, clinical classification. Figure 1 diagrammatically illustrates contused and fracture injuries of the kidney.

1. Contusions:
   a. Without subcapsular hematoma
      Mild contusion and slight tearing of the renal parenchyma not extending into the pelvis and without rupture of the renal capsule.
   b. With subcapsular hematoma
2. Fracture:
   a. Incomplete
      (1) Deep fissured fractures of the renal parenchyma and capsule not communicating with the renal pelvis. Therefore, hematuria is not marked and urine does not extravasate with blood into the perinephritic tissues.
      (2) Deep lacerations invading the pelvis but not involving the capsule. No perinephritic hematoma or extravasation of urine occurs but the hematuria is gross.
   b. Complete
      Involving parenchyma and both capsule and pelvis.
3. Tears of the renal vessels or ureter:
   Usually associated with other severe renal injuries but may occur alone. Internal hemorrhage and shock occur when the renal vessels are torn. Hematuria does not occur if there is no associated renal trauma or when the ureter is severed.

Diagnosis. A history of a blow in the flank followed with pain and hematuria indicates traumatic injury to the kidney. Young, healthy males are most vulnerable because of the active lives they lead. Of seven patients seen recently with uncomplicated rupture of the kidney, three resulted from horse kicks, a frequent cause in the rural areas. One patient fell from a merry-go-round, one fell from a golf bunker, a third suffered a flank injury due to a coasting accident, and the fourth was injured in a football game. While automo-

bile accidents are a frequent cause, other associated injuries usually occur.

Examination of a patient with kidney injury usually demonstrates exquisite tenderness in the costovertebral angle, side and upper abdomen, and if perinephritic hematoma is present, a mass may be palpated in the region of the kidney although usually the patient is so tender in this area that examination is difficult and unsatisfactory. If the patient is distended, slight generalized abdominal tenderness is present.

Early, the patient may present evidence of shock, usually due more to trauma to the nerve plexuses near the kidney pedicle or the adrenal gland or to the kidney substance itself rather than to loss of blood. Shock occurring several hours later due to hemorrhage is manifested by progressive anemia, increase in the pulse rate, drop in blood pressure, restlessness, thirst and pallor. Occasionally, patients with severe fracture of the kidney present no early evidence of shock. As a matter of fact, many of these patients continue with their work or play for some hours or even days only to seek medical aid as secondary shock from hemorrhage occurs, or when symptoms of progressive anemia occur, or when pain from increasing perinephritic hematoma becomes severe.

Abdominal distention from reflex paralytic ileus may so dominate the picture that possible rupture of a viscus holds the center of attention. This is particularly true in those cases of renal injury without blood in the urine. Or if hematuria is present, the kidney injury may be considered simply a complication and not of paramount importance. Hemoperitoneum at once suggests some intraperitoneal injury but may be due to leakage of blood from the perinephritic space through a lacerated peritoneum. In one case, massive hemoperitoneum occurred in association with gross hematuria due to simultaneous rupture of the left kidney and spleen.

It is axiomatic that the presence or absence or amount of blood in the urine is no criterion to the existence of, or the degree of, renal injury. Hematuria is almost

always present when significant renal injury occurs, but obviously hematuria is absent when the ureter has been severed or when the renal vessels have been ruptured and the kidney spared from injury, or when the fracture line does not enter the renal pelvis. Should blood clots block the ureter, hematuria disappears. In complete fracture, the path of least resistance for the blood to follow is out through the ruptured cortex into the perinephritic space so that in such instances hematuria may be quite inconspicuous. This was true in one case in which there were multiple complete fractures of the kidney with one completely detached fragment. Sometimes there may be a period of renal suppression in which no urine is secreted by the injured kidney. Quite obviously then, hematuria may be absent or inconspicuous for various reasons but in fully 90 per cent of cases, hematuria is prominent and is usually more massive and persistent than that seen in rupture of the urethra or bladder.

Positive evidence of kidney rupture does not complete the diagnosis. Possible associated injuries to other organs deserve consideration and the actual extent of renal damage should be established in order that proper medical or surgical treatment may be carried out.

Abdominal x-ray, excretory urography, or cystoscopic examination and retrograde pyelography are helpful aids in completing the diagnosis after critical clinical evaluation. Any or all of these accessory aids may be indicated. X-ray of the abdomen is disappointing because often the renal areas are obscured by intestinal distention which is difficult, impossible or inadvisable to relieve with enemas, cathartics or drugs. It should always be obtained preliminary to excretory urography and has value in demonstrating associated skeletal fractures such as fracture of the lower ribs or transverse process of the upper lumbar vertebrae. It may give valuable evidence of air under the diaphragm diagnostic of ruptured viscus, multiple intestinal fluid levels suggestive of ileus from intestinal obstruc-

tion or ruptured viscus. In one case the splenic flexure of the large bowel and small intestinal coils in this area were displaced downward and inward which suggested rupture of the spleen. This was verified by operation. The size and outline of the kidneys frequently can be seen if not obscured by gaseous intestinal distention. A grossly enlarged kidney shadow indicates marked kidney damage or perinephritic hematoma.

Excretory urography is the most valuable single accessory aid in diagnosis. The kidneys are much better visualized than on the plain film because the kidney tubules are filled with the contrast media and, therefore, the renal outlines can better be distinguished from the surrounding perinephritic structures. Often the severely damaged portion of the kidney does not excrete the media but usually the remaining renal tissue does, so that the pelvis and some of the calyces show in the films. Irregular filling and bizarre arrangement of the calyces are usually seen in excretory pyelograms when rupture of the kidney is present. Occasionally, the injured kidney fails to excrete the contrast media which is in itself diagnostic of severe kidney injury but is disappointing to the physician for no pyelogram is obtained and urinary extravasation cannot be demonstrated. If the media is excreted, there is no question that extravasation is present when a small concentrated collection of media is seen outside the kidney or ureteral areas. (Fig. 2.) When there are multiple renal fractures and a large perirenal hematoma, the urine and contrast media escape so rapidly and diffuse so quickly and widely that the extravasation is demonstrated with difficulty as a slight generalized increase in density in the perinephritic region. (Fig. 3.)

Cystoscopic examination may be indicated when the exact source of the hematuria cannot readily be demonstrated. Rupture of the urethra and bladder can be ruled out in this way although this is not specifically recommended. Observation of blood coming from a urethral orifice points to the corresponding kidney as the

source. Ureteral catheterization may be desirable if the ureter has become occluded by blood clots.

bed rest, sedation and general supportive measures. The patient should be kept in bed for a week or ten days to minimize the
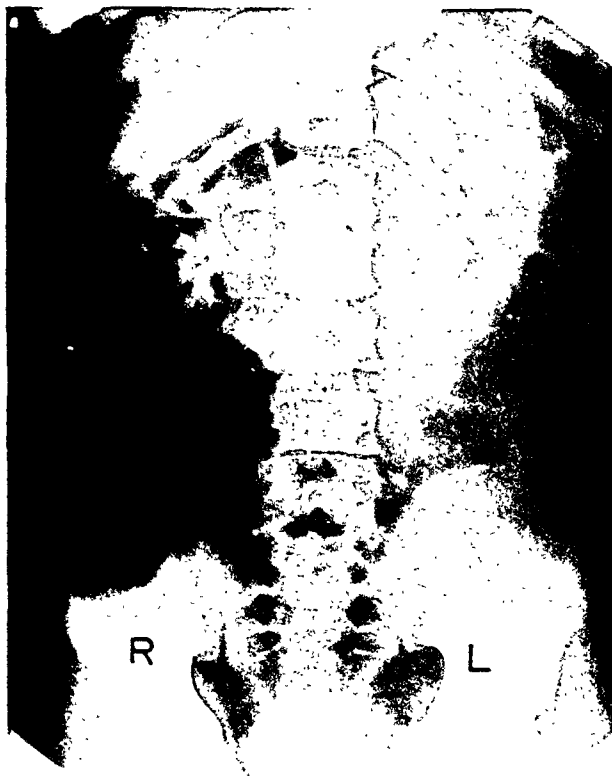
FIG. 2. Excretory urogram shows unmistakable extravasation of contrast medium into the perinephritic tissue in the region of the left renal pelvis. At operation the lower half of the kidney was almost completely detached from the upper half and the lower pole was completely severed and found lying free two inches below. Nephrectomy was done. Note the intestinal gaseous distention so frequently observed.

FIG. 3. Excretory urogram shows a zone of increased density surrounding the right kidney interpreted as extravasation of contrast medium into the perinephritic space. Operation demonstrated a huge perinephritic hematoma and multiple fractures of the parenchyma of the upper pole of the right kidney. The kidney was not removed.

When the excretory urogram is not diagnostic, one is justified in obtaining a retrograde pyelogram which readily demonstrates extravasation when present, and gives a clearer outline of the renal pelvis and calyces than most excretory pyelograms. (Fig. 4.) Since secondary renal or perinephritic infection may follow ureteral catheterization and retrograde pyelography, the danger should be emphasized and the procedure carried out in a strictly aseptic manner. When extravasation is suspected, sodium iodide should not be used because of the irritating nature of the drug. Drugs used for excretory urography can be used half strength for retrograde pyelograms with safety.

Treatment. The vast majority of minor renal contusions heal spontaneously with

danger of late hemorrhage. He should restrict his activities for another week or two because of the danger of hemorrhage due to secondary infection which may occur as late as one month after injury. Hematuria is no guide to the degree of kidney damage. Often hematuria of the frankest sort is seen in minor renal contusions which promptly subsides in a few hours or days, whereas no blood is seen in the urine in severe renal injuries if the ureter is severed or when the ureter becomes occluded with blood clots.

The patient with severe renal injury deserves meticulous observation. He should be kept at rest and comfortable by adequate sedation. Shock must be actively treated. A careful watch must be kept on the pulse and blood pressure. Clinical

indications for immediate urgent operation are persistent hemorrhage and sepsis. Hemorrhage is manifested by progressive

FIG. 4. Retrograde pyelogram demonstrates a double left renal pelvis with extravasation of the contrast medium from the upper pelvis. The excretory urogram failed to demonstrate satisfactorily the extravasation. At operation for drainage of an infected perinephritic hematoma, the kidney was found to be polycystic.

increase in the pulse rate or decrease in blood pressure, anemia, appearance of or increase in the size of a tumor in the renal area, and the appearance of free fluid in the abdomen. Sepsis from urinary extravasation is suggested by moderate or high elevation of temperature.

Elective conservative or radical surgery may be indicated on purely clinical observation but usually depends on more precise x-ray and pyelographic evidence. If each case can be placed in one of the three categories enumerated under classification, surgical or medical treatment becomes clear.

The small subcapsular hematomas absorb spontaneously. Surgery is indicated in large subcapsular hematomas and in those which lift the entire capsule from the parenchyma. Conservative surgery consisting of splitting the renal capsule

or decapsulation should relieve severe renal pain by releasing increased intracapsular tension and will minimize cicatrization incident to the healing process.

The smaller capsular and parenchymal tears in which the fracture line is narrow and does not enter the renal pelvis will heal spontaneously. Large hematomas absorb slowly and while surgical drainage is not specifically recommended if urinary extravasation has not occurred, it is quite effective treatment when other conditions warrant surgical renal exploration. If minor incomplete fractures involve the parenchyma and pelvis but not the capsule and no subcapsular hemorrhage occurs, operation is not indicated although in such cases the hematuria may be profuse and operation may be indicated on this ground.

Complete fracture involves the pelvis, parenchyma and capsule and permits perinephritic urinary extravasation. Surgical exploration is always indicated after control of primary shock and before secondary shock from hemorrhage is manifest. In such cases the perinephritic hematoma is removed or drained, the kidney is inspected and if injury is not too extensive, the separated fragments may be approximated by suture with ribbon catgut as recommended by Lowsley. If the capsule is not intact, this method of repair is not feasible. Mattress suture with ordinary catgut always causes some renal parenchymal damage. If hemorrhage is active, a bit of perinephritic fat held in the fracture line with ribbon gut is an effective hemostatic. If there is no active hemorrhage and if the fragments are only slightly separated, simple drainage without repair will be sufficient. Any bloodless or devitalized kidney tissue must be removed.

When laceration of the renal vessels occurs early, renal pedicle ligature and nephrectomy is life saving. Ureteral anastomosis of the severed ureter is feasible but quite theoretical for usually associated extensive renal damage requires nephrectomy. It is desirable to inspect the upper ureter in all cases in which the injured kidney is repaired and left in situ.

The most logical approach to the kidney is through the loin, exposing the hematoma first and freeing the kidney extraperitoneally. When the spleen is thought to be involved it can readily be inspected through a left lumbar kidney incision and removed through this approach as was done in one case. A transperitoneal approach is not desirable but should rupture of the kidney be found during intra-abdominal exploration, renal pedicle ligature is readily accomplished followed by transperitoneal nephrectomy. Conservative renal surgical maneuvers using the transperitoneal approach are not desirable.

Single or multiple Penrose drains should be inserted and brought out the posterior angle of the incision when extravasation or hematoma is present.

SEQUELAE

The traumatized kidney always heals by fibrosis and the injured parenchyma is replaced by cicatricial tissue. The greater the extent of injury and the more widely the fragments are separated, the more cicatrization occurs. Therefore, there is always some loss of functioning renal parenchyma and frequently one or more of the major calyces is obliterated. If perinephritic or subcapsular hemorrhage is not absorbed, organization occurs which causes thickening of the fatty or true capsule and this may compress the renal parenchyma. This may be the explanation of renal hypertension occurring after renal injury.

Infection must be anticipated when extravasation of urine occurs. Late perinephritic abscess from infected perinephritic hematoma is serious and can be avoided by early operation. Prompt drainage when perinephritic abscess does occur is desirable. Renal infection and late chronic pyelonephritis frequently follow kidney injury with extravasation. Renal stones are said to occur relatively more frequently in traumatized kidneys. Hydronephrosis may occur as a result of upper ureteral stricture resulting from periureteritis from infection.

Spontaneous or operative evacuation of infected extravasated urine may result in a persistent lumbar fistula if normal ureteral urinary flow is partially or totally impaired by ureteral stricture. Appropriate early operation should minimize this hazard but if it occurs, secondary plastic operation may be necessary designed to remove the ureteral obstruction.

SUMMARY

1. Seven recent severely ruptured kidneys are analyzed. Six had early operation. One had an associated rupture of the spleen. There were no deaths.

2. Early operation is stressed, but only after primary shock from trauma to nerve plexuses about the kidney pedicle is controlled and before secondary shock from hemorrhage occurs.

3. Preoperative evidence of urinary extravasation is demonstrated satisfactorily by intravenous urography. Retrograde urography is thought to be unnecessary and undesirable except when additional information is essential.

4. Urinary extravasation always indicates severe injury of the kidney and is felt to be a specific indication for operation.

5. The presence or absence and the degree of hematuria are no criteria of the severity of renal damage.

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WAR WOUNDS*

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ANY wound sustained in war might have its counterpart in injury to the body in civil conditions. War wounds, however, tend to fall into certain categories. In each of these they are produced in numbers that have no parallel in times of peace. War is designed in terms of violence. In modern warfare, the utmost resources· of physical science have been drawn upon to produce mechanical agents of destruction, each more potent than the last. The human body, which has to endure this violence, is not susceptible of corresponding change. It is no better equipped to offer resistance to the impact of the explosive shell or the aerial bomb than it was when men fought only with arrows and with swords.

Medical science has had imposed upon it the task of rescuing the individual from the effects of injuries visited upon him with increased severity by the advancement of physical science.

The human body, consisting of soft tissues on a framework of bone, is invaded by bullets from a rifle more than two miles away and that travel toward him at the speed of sound; or its tissues are penetrated by and give lodging to particles of great variety from the bursting cover of a high explosive shell; or the organs within its lightly constructed cavities may be compressed by the detonation of bombs dropped from the sky; or the tissues may be crushed by contact with tons of steel in motion, or by the beams or masonry of falling walls. Bones are broken, vessels are penetrated, the body covering is burned; and the bodies thus weakened are further invaded by hosts of enemies that are invisible but actively destructive.

Surgery in war is directed imperatively to coping with these disasters. In one particular the human body is on a different plane from the agents of its destruction. A damaged airplane, a damaged tank, can be repaired from without. The body is the chief contributor to its own repair. The surgeon's problems are how to keep it alive; how to enable it to support its injuries; how to protect it against invasion from invisible enemies; how to enable it to resume its functions; how, in many instances, to preserve its appearance. For the solution of all these problems the surgeon looks first to what the body can do for itself, and next to affording such aid as will give it the best chance to do so successfully.

It follows that the organization for the care of war wounds is in some respects standardized, in others, infinitely various. Wounds involve loss of blood, and without an adequate supply of blood in circulation the body is incapable of offering effective resistance to the outrage to which it has been subjected. Hence, the first item of routine is to replenish the blood volume. Hence, the first procedure incidental to war surgery is the provision of blood and of plasma, now available on a scale never hitherto contemplated, to make possible the recovery from "shock."

Next, the body's equipment of aids to its recovery is impaired by pain. Hence, morphia may be given at the time of greatest peril. Rest for the disturbed tissues is a matter for later concern. Cold has an adverse influence, and the answer is in the provision of warmth. Fear and anxiety are also retarding influences.

Time is a factor of high importance. The body itself offers the first resistance to

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assaults upon it, but this resistance is good only for the first few hours. Organization for the care of the war wounded is, therefore, keyed to the earliest possible first and secondary care, and to the minimum of delay in clearing away contamination. How to inhibit bacterial invasion and how best to control and eliminate infection are subjects that command the widest knowledge and the highest skill. Chemotherapy, in many forms, enters into this phase on a scale commensurate with the aggregate of the injuries and their infinite variety.

A self service of which the body is incapable, its release from tissues that have been devitalized and are a menace to its safety and the extrusion of equally menacing foreign bodies, becomes the first actual, surgical service in many instances. How best to cleanse a wound; how best to keep it clean and give the injured tissues the rest to which they are entitled and which they must have if they are to react as desired; how to prevent infection or to control it; how best to lead up to the stage of decisive achievement in healing—these constitute the main body of war surgery.

It goes without saying that war wounds are of such variety as to command classification, at or soon after the first attentions, into all the divisions of specialized surgery. The head, the thorax, the abdomen, the great vessels, the limbs and joints, all demand the benefit of such specialized experience. The same is true of the replacement of lost tissues, notably that replacement of skin following burns, which aerial bombing and other factors of the mechanical aspects of this war have produced on a scale for which there is no precedent. Moreover, since the wounds in this war tend to be multiple, and therefore diverse, cooperation between specialists, e.g., between orthopedic and plastic surgeons, tends to become a feature of every center of surgical repair.

Tissue Destruction and Contamination. While the violence of the wound has induced conditions of shock which may have affected not only the blood circulation but any or all of the vital organs of the body, two other effects have been produced at the area of actual contact. One is that the force exerted by the missile may so completely disrupt the tissue with which it comes in contact as to render it incapable of resuscitation. Fibers in a muscle are forced apart. Having no blood or nerve supply left, they do not bleed or contract. Into the spaces formed by this disruption there is an outpouring of lymph. Edema follows. The mass becomes a medium for anerobic infection. The other condition is the contamination of the area traversed by the missile; dirt, morsels of clothing or other foreign bodies lodge in the wound, bearing with them the bacteria of infection.

In the one case, the dead tissue is to be cut away, without loss of time, clear back to the line at which the disruption ends. In the other case, with equal promptness, elements of contamination are to be cleared away and the wound made clean.

Traumatic Agencies of War. The severity of the wounds is to be inferred from the nature of the agencies that inflict them. In the main these are bullets, shells and bombs. There were these in the last war and in every war of recent times. To the classification hitherto existing are now added the tank and the airplane, both driven by highly inflammable fuel, giving to the casualties a proportion of burn injuries greater than in any previous experience. Moreover, the airplane, dropping explosive and incendiary bombs, has brought the civilian populations, behind the lines of battle, within the purview of the war wounded.

The bullet from a rifle now has a range of two and a quarter miles. It starts at a speed of 2,800 feet a second. Forty years ago the rifle bullet drilled a clean wound through flesh. That is seldom the case now, except at parts of the trajectory. Oscillation is caused by air pressure at the highest velocity, and the bullet may turn completely when nearly spent. The machine gun and the submachine gun have muzzle velocities of 1,000 feet per second or more.

The impact of any of these missiles disrupts and devitalizes the tissues with which they are in immediate contact. The wounds inflicted are of great variety: a clean drill, small entry and large exit wound and vice versa, shattering of the tissues at the surface or internally, or the bullet may come to rest in the tissues. ·

High explosive shells, covered with thick iron casing, which scatters at high speed when the shell breaks in particles of all sizes and weights, produce wounds that are the worst seen in warfare. Hand grenades, being of similar material, and which may be loaded with bits of metal, also make missiles of the earth and stones where they strike.

All of these missiles, besides being destructive to tissues, carry in with them particles of clothing, and the clothing possibly being dirty and the bearer of various forms of bacteria, foci of infection are simultaneously established.

The aerial bomb, on the other hand, has a soft coating of aluminum alloy. This covering, shattered by explosion to sizes varying from pinpoint to thumb nail in size, and which travel, for the first fifty feet, at 5,000 feet a second, at which speed they are of incandescent heat, have the most devastating effect on the soft media of human tissues. There is a tendency to multiplicity of wounds. These may be minute at the surface and of vast proportions within. Every surface wound demands examination to determine the internal effects.

Fire and oil bombs, incidental to aerial bombing, produce appalling burns, often with chemical erosion. As the first attack is on uncovered parts, extensive edema, with the face sometimes swollen to thrice its natural size, is characteristic; and the liberated gases produce gross lesions. The use of flame throwers adds to the aggregate of burns, as do the catastrophes encountered by planes in combat whose fuel takes fire.

Where so much dependence is placed on the destructive power of explosives, there is certain to be injury from compression as well as from actual wounds. The lungs and other organs may be subjected to grievous injury. This happens, notably, in connection with the explosion of ground mines, which constitute part of the answer to motorized aggressive warfare. In air attacks on cities, the young are the most numerous victims of compression.

The detonation of high explosives in a confined space, characteristic in the bombing of towns, is more disastrous, in this matter of compression, than was the explosion of projectiles in the open field in former wars. Many are killed without being wounded. The clothes are torn off others. There may be hemorrhages in the air passages and in the lungs. The symptoms are diminished movement of the diaphragm, fullness of the lower chest, signs of lobar pneumonia and pyrexia, extreme respiratory dyspnea, pain in the chest, even cyanosis. There may be rapid development of severe shock. The nervous system, the ear drums and the intestines may be affected. Abdominal pain is an invitation to "look and see." In any exploration, it is best to avoid using other than local anesthesia.

Another by-product of aerial warfare on towns is the number of injuries from being crushed for long periods under falling walls or timbers. Uremia and anuria command immediate attention.

What is notable about the present war, as compared with others, is the multiplicity of wounds that may be received by the same person at the same time. Attack from above as well as from in front, together with the incidence of dispersal of fragments after explosion, produces a reaction that has caused this to be called "the war of the crouching man." Wounds in the back are common. To know the position of the patient when the wound was received may be the best guide to determine the route of the missile along the tissues or across them.

The Time Factor. In any planning for the healing of war wounds, the first importance is to be assigned to the time factor.

The reason for this is that the body instantly concentrates its protective forces upon the area in which the insult has been received. The effectiveness of this protection diminishes rapidly. It is at its best in the first few hours. It must either be sustained at that level or be brought back to it. Once there is a breach of the body's covering, the way is open for invasion of bacteria. From that instant the fight is on. The body takes the aggressive, sending out to the exposed surface liquidbearing cells for the construction of a cover and cells to combat the anticipated invasion. War wounds are apt to be contaminated, for example, by dirt carried in with the morsels of clothing. It is calculated that there is a margin of four to six hours, hardly ever more than twelve, within which, if contamination can be removed, infection may be averted. After twelve hours clean healing is not to be looked for. The lucky patient is the one who has his wounds cleaned quickly after they are inflicted. Plans for transportation of the wounded are made with this in view, but the incidence of battle generally operates against advantage being taken of the time lag. The patient and the surgeon enter upon the combat with the invisible enemy, and the weaker the patient is, the more assiduous the surgeon must be in restoring his capacity for resistance. It has been said, "His task must be to co-operate with nature, and direct his actions so as to imitate nature's own methods of protection."

Blood Supply the Critical Factor. The essential explanation of differences between early and late attention to wounds lies in the fact that the process of resistance reacts upon the blood supply, by which the equilibrium of security is sustained. The volume of fluid within the circulatory system is a relatively small part of the fluid content of the body, but it is in immediate contact, at the capillaries, with the all-pervading lymph, and therefore with the cells invested by the lymph. When the fluids rush to the injured parts as exudates and the fluid reservoir is progressively drained, the liquid content of the blood stream seeps through the capillaries to replace the lymph that is thus withdrawn. Since the liquid of the arterial blood stream thus tends to be withdrawn from the normal course of return through the veins, there is reduction of the volume to be oxidized and consequent concentration of hemoglobin. The nice balance of the capillaries is disturbed, and through these more than normally permeable endings the drain continues. Nature's capacity to contribute to healing by first intention is impaired by the inadequacy of the blood supply, whether the reduced volume is due to hemorrhage or to withdrawal from the system of the plasma fluid and the proteins it holds in solution.

At the outset, the failure of the venous return is a threat to the life of the patient, greater or less according to its degree. Of this the blood pressure is the index. Restoration of blood volume, with normal hemoglobin concentration, is essential, in the first place, to save the life of the patient. It is equally essential in assuring the blood supply necessary both for healing, if there is no infection, and for combatting infection if infection is declared.

The availability of blood plasma in the period of "shock" and afterward is what gives the wounded now a much better chance than the wounded had in any other war.

Blood Transfusion. Where the depletion of the blood volume is due to hemorrhage, replacement of the loss with whole blood has always been considered desirable. In war conditions this is difficult. If direct transfusion from donor to recipient can be arranged, there is the all important matter of matching types of blood. In the best conditions this means delay. Error in matching may produce reactions that deprive the procedure of the expected advantages. Again, while it is possible to have citrated blood at hand, the probability is lessened in that it tends to hemolysis when transported. Fifteen days from the time it is taken is an outside limit. Actually, if it has not been used in from

two to three days the plasma liquid is removed under a process designed to insure a sterile product, from which the hemoglobin and some other cells have been precipitated, and in which the blood proteins are held in solution. This continues effective for use over a much longer period. By eliminating the water and keeping the residue in a dry, desiccated form, it may be sent anywhere, in any quantity and kept indefinitely, and be administered in a distilled water solution. Again, the plasma may be frozen, kept in a refrigerator and thawed when it is to be used.

It is evident that, if the results that might be obtained by the transfusion of whole blood can be in large measure attained by the employment of desiccated plasma, and the plasma is on hand, while the whole blood transfusion is invested with delay and difficulty, it is the plasma that will dominate in the treatment of war wounds both on land and at sea. Wounded men on a war ship must be transferred to a hospital ship. Wounded soldiers must be carried by stretcher, by ambulance and then by train to some distant point. Both involve delay and the time lag operates progressively against the patient.

Plasma. Substitution of blood plasma for whole blood in transfusion has been under experiment for twenty years, but it was not until the outbreak of the war in 1939 that the change over was made on the grand scale which has had, as one result, the possession by any surgeon in his own office of the materials necessary for such infusion for use at a moment's notice.

Once it was established that the purpose would be as well served by plasma as by whole blood, the time element dominated the situation. In any condition, the time spent in obtaining the necessary Wassermann-negative and compatible donor could be the cause of fatality. In war conditions, with shock and depleted blood volume a matter of hours or even minutes, and a multitude of cases to be treated, delay could not be contemplated, if there was an alternative.

The preference for plasma, moreover, strikes deeper than that. It is not, as might be assumed, second choice, as compared with whole blood. With whole blood the emphasis is on the red corpuscles, and it is now perceived that, even in relatively severe hemorrhage, loss of red cells is not the important matter. There are enough left to go on with, and their replacement can be counted upon. The loss of proteins and of the liquid holding them in solution, from the blood stream, is of much wider significance.

In trauma, loss of blood, fear and cold induce hyperactivity of the sympathetic nervous system. There is, perhaps, most notably in extensive burns, a rush toward the area of injury of exudation of fluid with high protein concentration. This is the first effort made by the system in the process of healing. The sympathetic nervous system operates to assist in this flow, and in doing so, to increase the permeability of the blood capillaries. Through these openings even red cells may pass out into the extracellular interstices, instead of being retained in the circulation. The principal drain is, however, of the protein bearing fluid, rushing to the work of cellular repair and regeneration which cannot take place without certain essential amino-acids. As this loss becomes progressive, there is a reduction of the colloidal osmotic pressure of the remaining blood, which thus is rendered unable to draw on the extravascular reserves of fluid and so to replenish the diminished volume within the vascular bed.

Whether there is more or less fluid in the veins and arteries, or a higher or lower red cell count, is not, of itself, the important matter. The battle front is in the cells, which are impaired when oxidation fails, as it does when the accustomed amount of blood is no longer present in the circulation and the blood volume is inadequate to the field to be covered.

While liquid volume can be restored by the addition of isotonic solution, any gain is only temporary. The solution does not replace the protein carrying plasma liquid,

and since it does not belong, it is soon excreted. When, on the contrary, the blood proteins available in desiccated plasma are given in sterile water, in two or three times the normal concentration, not only does the solution replenish the blood volume but the demand of the surplus proteins for liquid to reduce their concentration, actually reverses the tide, drawing back fluid from the tissue spaces into the vascular channels. This may take time, but when it happens it ends the imbalance that accounts for what is conveniently called shock.

Two comparisons serve to emphasize the separate importance of the protein bearing plasma liquid as a constituent of the circulating blood. One is the failure of isotonic solution to replace it. The other is that while in whole blood transfusion, the red cells of noncompatible donor blood may be destroyed by the plasma of the recipient, transfused plasma does not destroy cells of the recipient, a difference almost conclusive of preference for plasma infusion. When the liquid tide turns toward the vascular bed for adjustment of protein concentration, it draws back into the blood any red corpuscles that had been washed into the extracellular spaces. Nor does the return of the blood's capacity to restore oxidation at the cells conclude the chapter. The distorted ratios of sodium and potassium within the cells and outside them also find adjustment. Finally, there comes that saturation of reserves of protein in the body that is of great importance in relation to recovery from infection.

The plasma bank, offshoot of the blood bank, called into being by the war and developed on a scale without parallel in the history of medicine, may be said to have been the means of restoring to the body, after wound or burn trauma, the capacity for healing and for more effective resistance to infection. Therein lies almost the whole difference between the direction surgery has taken in this war and the surgery incidental to all former conflicts.

Infection. The skin is the protector of the body against invasion by the organisms of infection. Any breach of its continuity is an invitation to such an invasion and any of these organisms may be found in any wound. The immediate response of the body is to set up a protective barrier at the part thus exposed. The effectiveness of that protection depends upon the adequacy of the blood supply. A fibrinous, vascular, granulation tissue is formed outward from the surface. There is activity by the phagocyte cells in this tissue, and the blood and fluids which continue to be directed to the tissue in the period of growth are endowed with bactericidal power. The body applies its resources to restoring the equilibrium that has been disturbed. The invasive bacteria oppose that restoration. The fight is between the patient and the invisible enemies.

It is obvious, therefore, that the rôle of protein bearing plasma, important as it is in meeting the "shock" emergency by the replenishment of the depleted blood volume, is of even greater significance in equipping the blood stream for major effectiveness in the continuing process of healing. It has provided the kind of aid that is indispensible to the control of infection. Being without it in other wars, surgeons had to make the best of minor factors, such as antiseptics, which proved inadequate to the purpose. With a more dependable blood supply, the tendency has been to discard the antiseptics, thus eliminating such harmful action upon the granulation crust as had to be tolerated in the earlier conditions. Decisive, in this sense, has been the abandonment of the tannic acid method. What the formation of a crust by this method did to slow up the fluid exudations, and so let the system recover, is now done from within the system; so that, if there are areas of infection, they are no longer concealed by a crust.

In the nature of things, wound areas are exposed to a variety of infections. Some enter with foreign bodies, as with bits of clothing. If the clothing is dirty, it may bring in tetanus. Muscles devitalized by impact furnish a favorable medium for gas

forming anaerobes, the ensuing necrosis conducing, if not dealt with in time, to the putrifaction and liquefaction that characterize gas gangrene. The pyogenic aerobes and the sporing anaerobes, between them, threaten pus infection, gas gangrene and tetanus, three formidable opponents of healing and health.

In the field of pyogenic infection the most to be dreaded is Streptococcus pyogenes, since if it gains access to the wound it may invade the tissues before the defensive reaction has begun. If the infection begins after granulation has started, it may go unnoticed except under bacteriological examination. If neglected, it may set up toxemia, and a septic arthritis would be consistent with its affinity for joints. This emphas zes the importance of close co-operation between the surgeon and the laboratory during the period of effort to control infection, if one cannot prevent bacterial invasion.

Staphylococcus aureus may be considered the next most menacing, since, if it invades the tissues, it may set up a subacute pyemia or even a fulminating septicemia. Staphylococcal infection may give rise to metastatic abscesses in lungs, kidneys, brain or heart.

Bacillus proteus and Bacillus pyocyaneus are less dangerous, but they spread easily and as they compel interest in themselves by sight and smell, may mask the presence of more pathogenic bacteria. Also they are capable of spoiling a good skin graft if left below it.

Of the sporing anaerobes or clostridia, Clostridium welchii is more frequently encountered than the others, is more toxigenic than invasive; Clostridium oedematiens is mainly toxigenic; and Vibrion septique is both. These anaerobes frequently are isolated from wounds not affected with gas gangrene, as is Clostridium sporogenes which is hard to separate from the more pathogenic clostridia.

The sporing anaerobes, including tetanus, appeared in wounds received on battle fronts of highly cultivated territories. They were present in the soil and the soil was present in garments and on the skin.

It is the anaerobic spore bearers that first contaminate war wounds and are, therefore, if not promptly cleared away, the agents of primary infection. The streptococcal infections are secondary, in the sense that they are of later occurrence, but it is they that are responsible for septicemia, pulmonary complications, joint infections, prolonged invalidism and loss of function. It does not help matters that they too often are introduced by those who care for the patient in transit and in the hospital.

BURNS AS WAR WOUNDS

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BOTH actually and proportionately there are more burns in this war than in any war that preceded it. It is a war made with machines driven by oil or gasoline, ships, tanks and airplanes. Men operating these are exposed to burns when the fuel on which they depend is set afire. The plane has the predominant rôle in the war, so far as burns are concerned. The pilots are themselves exposed to sudden bursts of flame in the air or on the ground. Planes are sent to attack tanks, and if they succeed there will be burns for the men shut up in the tanks. Planes are sent to drop explosives on warships, and may blow up the magazine or set fire to the fuel. Those in range of the flames, as they may be even when in the water, get burned. Planes drop explosive bombs on buildings and the buildings burn. Those in or near them do not always escape the flames. Then there are the bombs that are primarily designed to be incendiary, rather than shattering. Humans do not escape their attention. Burns from flame, cordite burns, phosphorous burns, electric burns, burns by chemicals, the airplane contributes to multiplication of all of them. Nor is the exchange of such injuries restricted to those in the opposing forces. The airplane has brought the civilian populations of the contending countries within the range of burn infliction.

Nor do numbers tell the whole story. A burn may affect a small surface, or it may injure a tenth, a quarter or a third of the skin covering of the body. It may only inflame the outer layers, or it may destroy the skin in its full depths, tear away sections of it, and even invade the soft tissues, tendons, vessels and nerves it overlies and protects. We speak of three degrees of burns but the differences account as readily for six.

All burn problems have one factor in common. Where there is loss of the skin cover, whether the amount of such loss be great or little, the part denuded must be covered by skin. Treatment of a burn should be consciously directed toward the ultimate replacement. When it is ready for that stage it should be under immediate direction of the surgeon who is to effect the replacement, and he, wherever possible, should be one whose experience and acquired skill offer the best warranty of success and satisfaction. The ideal situation is that in which the competent surgeon directs the preparation in all its phases. If numbers render that unattainable, as in war they may, patients should be assigned, in the later stage, to a center for replacement, and as soon as practicable after the injury, sent to centers devoted wholly to those suffering from burns.

In comparing the treatment of burns in the present war to that of other wars and of civilian practice, there are two features of outstanding interest and importance that are new. One is the availability of plasma as an adjunct in control of the "shock" that results from severe injury. The other is the use of the sulfonamides and some other preparations in the control of infection. Each has had an influence on current practice that can be properly described as revolutionary. In combination, they have displaced that tannic acid coagulation which was standard practice when the war began, and have led to skin grafting being set for a few weeks after the injury, instead of accepting the delays that in many instances have had disastrous results.

The plasma bank, as we now know it, did not exist before 1939. Sulfanilamide spraying of open wound surfaces, including burns, dates only from the civil war in Spain. It fell to my lot to be the first, as far

as I know, to apply sulfanilamide to the control of infection in war wounds.

When I accepted an invitation to organize a service for the wounded in that war, there was no available supply of tannic acid or silver. I did have at my command an ample supply of magnesium sulfate, and also, through the friendly co-operation of the Winthrop Chemical Company, a supply, for internal administration, of neo-prontosil and neo-prontolyn. In 1939, I wrote an account of my experience in Spain, including what probably is the first record of the use of sulfanilamide as a surface dressing to combat infection in war wounds, many of which were burns.

Quite remarkable success was attained in control of infection, and, there being no tannic acid crust to make for delay, the natural progress was from a clean wound to early skin grafting. I do not disguise the satisfaction there was in finding, late in 1942, that the method I adopted in face of difficulties some years earlier was being given the widest application in British war hospitals, to the practically complete exclusion of the tannic acid method.

Whatever may have conduced to acceptance of the view that a burn wound can be skin grafted in a few weeks, the fact itself is of the utmost importance. How disastrous delay may prove to be was illustrated by a case recently referred to me, that of a young man, whose hands were badly burned in one of the great steel mills more than a year before I saw him. The utmost function of which his hands were capable was an inadequate approach by the thumb and index finger of each hand. Hypertension at the knuckle joints, ankylosis of the others, immobile flexion, and distortion, all are to be accounted for by the contractures resulting from leaving the burned skin in place, whereas if replacement had been early, after-treatment with replacement in prospect, this disfunction might have been averted.

Decision on a matter of such importance turns, of course, upon accurate estimation of both the primary and the secondary injuries caused by a burn.

First, there is pain. For this there must be relief, and for that relief morphia is administered. Veterans in surgery do not shrink from giving doses large enough to control the pain. One of them has said that "morphia never killed anyone in pain." Most probably the pain is related to the nervous reflex from disturbance of organs and viscera. Allied with the pain is the fear that even the bravest experience. Frequently the neurosis set up, as traumatic shock is followed by rapidly accentuated weakness, is beyond the patient's control. It has been said that no one severely wounded in war is ever free of this neurosis in after life. At the initial stage it may present conditions of great difficulty in handling the patient.

Second, the response of the body to a burn on its surface is an outpouring of exudates of which water is the chief constituent. As the liquid leaves the interstices of the tissues, other liquid rushes into the space vacated. The only source of such replacement is the plasma fluid of the blood in the circulatory system. The resistance of the capillaries, which normally regulate the turn from the finial arteries into the return systems of veins and lymphatics, is overborne, and the plasma liquid is withdrawn from the necessary blood volume into the tissues, tending to outward movement toward the surface further to increase resistance to dehydration caused by the burn.

It was to check this effusion to the surface, with its disastrous consequences to the interior of the body, that the tannic acid treatment was introduced. The crust formed by the action of the acid on the exuded sera became a check upon the outpouring of liquid. The limitation upon the effectiveness of this method was that, if there should be agents of infection below the tannic crust, nothing could be done to control the infection until the crust had been removed. Every surgeon has had cases, as I have, in which removal of

the crust was the first step toward beneficial treatment of a burned area.

When the plasma fluid leaves the vessels in considerable volume, and passes into the interstitial spaces instead of the capillary venules, the blood volume of the veins decreases; when oxidized it does not fill the arterial system, the red cells concentrate for want of the liquid by which they are normally held in solution, the blood pressure fails, and the tissues of the whole body are left without the sustenance from the blood they need in the emergency.

Tannic acid checked the outpour. Plasma replaces the lost fluid. Tannic acid helped the body restore the water balance, but slowly, and from materials held by the tissues. Plasma adds to the blood volume within the walls of the circulatory system, where it is most needed, and with no delay.

Administration of water would tend to restore the balance, but in severe burn conditions it is not retained in the blood. Isotonic saline solution may last longer, but is soon excreted, and the hemoglobin concentration continues. What makes plasma infusion more effective is that it carries with it the liquid proteins that are requisite to the blood and that resist the processes of excretion by adhering to the vessel walls until they become incorporated in the blood fluid.

There is a third reflex from the burn trauma. The cortex and medulla of the adrenal gland are affected. There may be hemorrhage into the tissue spaces of the cortex, and even destruction of the cortical cells. Herein may lie the explanation, at least in part, of the failure of the capillaries. While it has been demonstrated that the capillaries have an independent control, associated with the pituitary gland, pituitary extract has proved ineffective in cases of burn. On the other hand, adrenal cortical extract has proved to be of definite advantage when administered in secondary shock conditions. Its rôle would seem to be that of countering the element of traumatic shock while the plasma fluid redresses the loss of blood volume and accessory proteins.

The relief thus given operates also to renew the normal shift of fluids into the circulatory system, and so to further fit the body for the processes of recuperation involved in cleansing the wound and preventing infection or in combatting infection if it appears.

The fact that plasma has been supplied in quantities hitherto unthought of is to be attributed to the knowledge, and since 1939 the experience, that aid must be given to great numbers of subjects, and, even more important, given within forty-eight hours of the injury, sometimes within twenty-four hours, sometimes as late as seventy-two. To deal with such problems, the plasma liquid with its protein content, or the desiccated proteins in distilled water solution, must be available when needed. Infusion of whole blood, except in the case of severe hemorrhage, would not serve the purpose as well, since it would not lessen the hemoglobin concentration. In any event, the delay, incidental to matching blood types, may render infusion of the whole blood impracticable in this kind of warfare.

Except to remark that refinements of method with a view to producing plasma that will be sterile when its use is required, are being constantly improved, we need not here go into the methods of production, other than to note that they consist in the precipitation of the red cells, and some others, leaving a clear fluid in which the blood proteins are retained. In a supplementary process, and in deference to the knowledge that the liquid plasma is a rich culture medium, the essential components are made available in a dry state.

Laboratory estimation of hemoglobin concentration affords a good idea of the amount of infusion required. With a normal 100 per cent of hemoglobin there is a normal blood volume, of which the average would be about five liters. Of this, about three liters would be plasma fluid. Increase in hemoglobin concentration may be taken as showing a loss of blood volume, roughly proportionate in reverse. Thus a 10 per cent increase in concentration means a 10 per

cent loss of fluid, which only plasma will replace. An amount so calculated may be given, intravenously, while preparing for cleansing the burned area. A liter is the usual first infusion. After the cleansing, more may be given in keeping with the hemoglobin estimation. During the later infusions, which may run to three or four liters before stability is established, given at a drip speed of about ten a minute, there should be careful and repeated observation to avert overdosage.

Since we know that when the blood volume has been re-established and the permeability of the capillaries has been readjusted so that blood supply and returns function normally, the body will proceed to build up a granulating covering up to the skin level by means of exudates, and that in the best conditions this may take no more than three weeks, the cleansing of the skin and the prevention or control of infection are to be begun at the first possible moment.

An infection is something to be foreseen and, therefore, to be prevented; and as invasion by streptococcus is the one most to be apprehended, the burn area should be dusted with sulphanilamide or sulfathiozole, both of which are bacteriostatic as to these germs, even before the patient reaches the hospital.

Nearly always there is contamination, and while contamination is not infection the first cleansing procedure is addressed to its elimination. Morsels of clothing and of burned tissue are to be cleared away, with liberal douching of sodium hypochlorite (Milton) or magnesium sulfate.

When infection manifests itself, I hold that the best results, looking to its control, are to be had through close co-operation between the operator and the laboratory. Before infection can be fought successfully one must know what kind of invisible life is responsible for it, and on that point the laboratory will supply information that cannot otherwise be obtained.

If the laboratory tests show streptococcus, the origin can be ascribed to conditions within the wound area. To combat such infection is the really serious problem. Too often the laboratory findings point to infection having been introduced by some member of the team; or from cross infection within the hospital; or from infected air of the particular room. Where the reports show Bacillus faecalis, pyocyaneus or Staphylococcus viridens, there is no escape from the deduction that it has been brought to the wound from somewhere along the line of the team, whether operator, dresser, assistants, nurses, orderlies or others who have been in contact with the patient. Burned patients have no effective resistance to offer to such invasion. Where there are numbers of cases to be dealt with the danger increases. The most meticulous care must, therefore, be taken from the outset to guard against infection from hands, gloves and spray in breathing. Particularly in centers to which burned patients are distributed in war time, this concern for cleanliness, masks, etc., has come to be a rigid routine. Indeed the assurance that such concern can be counted upon is one of the reasons for establishing such centers.

Every effort should be made to eliminate these secondary infections in the early cleansing of the wound, and, later, to guard against a dressing or the waters of a bath becoming unsterile.

To illustrate the advantage there is in collaboration by operator and laboratory, it may be mentioned that the antiseptics, or rather the bactericide and bacteriostatic compounds whose exceptional value is now being demonstrated, are selective in their attack. Thus while one of the new compounds, called "propamadine" in shortening the technical word of forty letters, will dispose of a persistent streptococcal infection, such organisms as Bacillus proteus and Bacillus pyocyanea actually flourish in its presence, and that fact, if undetected, has been known to lead to failure of a thin epidermic graft, the skin graft whose "take" is more certain than any other.

The best cleansing material for a burn wound is the cetyl trimethyl ammonium

bromide, of Colebrook, in 1.5 solution, applied without anesthetic for three minutes. The wound is then washed in sterile saline to admit of taking a second swab for laboratory report. In this cleansing the effort is made to eliminate all contamination, especially morsels of burned skin, particles of clothing fabric, and any other foreign matter.

It is now accepted that the antiseptics which were in favor only a few years ago are of no practical service in the control of infection. The sulfa compounds, on the contrary, have demonstrated their value.

Sulfanilamide, as a preventive of infection, is applied lightly, as a powder, at the earliest opportunity. After the cleansing of the wound, it is again applied, this time in the form of a cream, from which there is a steady emanation upon the wound. This avoids the risk of caking, and of entering the system. If its systemic use is found desirable, it is utilized in the manner suited to that intention. The purpose of the cream dressing is to prevent the multiplication of bacteria on the burned area.

The cream is compounded of

	Per Cent
Sulphanilamide...	10
C.T.A.B.	1
Castor Oil	25
Beeswax	1.8
Wool fat	1.8
Cetyl alcohol in water	5

This is applied on sheets of gauze, covered with wool, and bandaged. It is left from seven to twelve days and may be renewed for another four to six days.

If when the dressing is removed the burn shows exuberant granulation, is grayish, sensitive, with wet discharge and without peripheral epithelization, infection is not under control. The laboratory will show to what this is due. If it is due to lack of precautions somewhere in the staff, measures will be taken accordingly. The agents of infection most to be dreaded are Staphylococcus hemolyticus, Streptococcus hemolyticus, and, more potent than either, beta streptococcus hemolyticus. The compounds used against them begin with those that are

bacteriostatic, followed, at need, by those that are bactericidal. This may mean a nice selection among the sulfonamides, as a beginning. If the result is not satisfactory, very remarkable results have been obtained by recourse to penicillin. This substance, derived from a fungus, and administered in a watery solution, is bacteriostatic, and brings remarkable aid to the body defences, which destroy the bacteria while the penicillin prevents their multiplication. A third recourse is to propamadine, strongly bactericidal.

For control of elements of infection other than streptococcus, if change of dressings reveals an unsatisfactory condition, recourse is had to sodium hypochlorite (Milton) in strength of 1 in 20 to 1 in 7.

When, after sloughing is complete, the burn area is a healthy red, it means infection has been controlled, and skin grafting follows.

There is, in the nature of things, considerable diversity in burns. They differ as to depth, location and extent. While they all come under the same series of treatments; shock, sedation, cleansing, control of infection, and eventual skin grafting, it is evident that a burn on the face calls for something that may not be demanded in a part habitually covered. A burn on the hand, with its complex attributes of function, presents other problems than would a burn of similar extent on the adjacent forearm. And a burn that deprives the body of from a tenth to a third of its skin covering makes heavier demands on the operator's knowledge and skill than does one of more modest proportions.

We may take first the burn that destroys large areas of skin, as on the neck and chest, the back or abdomen, the arms or legs, or some of these in combination.

There are limits to the pain anyone can endure, and the cleansing of the burn areas will go very much better and faster if the pain can be overcome. The best way to do it is to immerse the patient in a bath of sterile saline solution maintained at about blood temperature, and in a warm room.

By slings from the sides of the bath he can be assured a restful position, the water makes a good cushion, and the heat gets rid of most of the pain. The dressings drop off of their own accord, and after a half hour or more the burn area can be explored by the attendant, with gloves and under water, for the removal of every sort of detritus, dead skin, or whatever would harbor the bacteria of infection. This method has been developed on a war scale by McIndoe.

In these cases there may be no epithelialization at the edges of the wound, and burnt epithelium piles up on the granulating base, tending to infection and rendering sterilization difficult. Practically painless removal of these accumulations is a good start on the way to healing, and this becomes possible with immersion twice a day for periods that will not weaken the patient. He there has a freedom of movement not practicable elsewhere, and his comfort operates to avert disturbances of function, as of hands and feet, that might otherwise supervene.

The sulfanilamide treatment goes along with the immersion. Before it began he had had the wound area covered with one of the sulfa compounds, given in lanette and covered with tulle gras or vaseline gauze. This loosens off in the bath, and is renewed when he is transferred, naked, to a sterile sheet in a tented bed and kept warm by radiant heat lamps. The tulle gras or vaseline gauze is overlaid with saline packs. If the burns are front and back, the one on which he is to lie is dressed before he is transferred to the sheet and tented bed.

The immersion principle can, of course, be applied to small areas as well as large, with vessels to suit.

Also, at the conclusion of the treatments for cleansing and to control infection, large areas as well as small can be skin grafted, and should be. It may be that only pinch grafts can be employed, but these, as will be seen later, constitute effective replacement of the lost skin.

In the treatment by immersion the comfort of the patient is recognized as a factor of prime importance to the operator. It is even more than that, for it is well established now that everything which tends to restore the body's own capacity for resistance and repair is a definite aid to the healing process. Warmth, as we have seen, is one contributory influence. Rest is another. The value of rest to the tissues is what dictates the enclosing of wound areas in plaster casts when the patients are to be moved for considerable distances before they can receive full attention.

The same principle is applied, in some instances, to the treatment of some wounds and burns. While open treatment is in the main to be preferred, there may be an advantage in casing the arm in plaster or crilex when the burn is on the hand, or the hand and arm. After the first dressing, if the arm is thus enclosed there is security against cross-infections from outside, and also a stay of the lymphatic process by which any infection within the tissues of the arm might be carried into the system.

It is probable, moreover, that when there is a severe burn of the hand, and accompanying excitation of the tissues of the arm in which the tendons leading to the hand are imbedded, this excitation may account in part for the hypertension and static flexion typical of hand disfunction in these cases of burns. Rest given to these arm tissues, by the plaster cast, tends to avert this disturbing action while the hand is being prepared for reception of a graft. The hand itself is never so enclosed. Maintained in the "position of function" or the "position of grasp" it is prepared, like any other burn, for the reception of a graft. The basic position for rest of the hand begins with slight dorsiflexion at the wrist. Fingers are at mid-flexion at all joints. The thumb is in apposition with the tip of the index finger. The long axis of the fingers points toward the lower radius. The wrong way is to place the hand in full extension. It drops at the wrist, the fingers become hyperextended at the metacarpophalangeal joints, the long and short flexors of the fingers and joints become acutely flexed,

and we have the irretrievable disaster of the "claw hand." Air pilots cannot be exposed to that fate, and it is they who get the larger share of hand burns. For the dorsal area and the fingers, an intermediate epidermic graft gives a flexible covering with normal coloration. On the palm a covering of greater density is required. Even where there is known disturbance of the tendons, which must be left for later attention, the covering should be gone on with. If the necessity of a later operation is foreseen, which means that the covering must be opened, the palm cover might be with a pedicle flap rather than a free full thickness skin graft, since in the latter the subcutaneous tissue and part of the corium are removed before transfer to the defect. When an intermediate or full thickness skin graft is applied over an area that has been treated for burn, and when the defect apparently has been cleared of infection, it is a wise precaution to infiltrate the space between the wound and the graft with prontosil, for greater security.

Another variation from the open healing method is that in which recourse is to the Bunyan plan for frequent irrigation within a bag of specially woven silk. After surgical removal of burned tissues and liberal douching with sodium hypochlorite (Milton), an arm, for example, is enclosed in the bag, which has inlet and outlet openings, and irrigation with the hypochlorite solution is made three times a day for twenty minutes.

Infection material collects on the lining of the bag, which must be sterilized and renewed. It does protect the burned area from infection from outside. It is a convenient resource when local irrigation is desirable, but since it is not effective in demonstrating that the hypochlorite masters all bacteria its use, like that of tannic acid, tends to be relegated to the history of surgery.

Burns from phosphorus, all too numerous in the kind of warfare that includes the burning of cities by means of incendiary bombs dropped from airplanes, call for special treatment. The burn is immersed, if possible, in a weak solution of sodium bicarbonate. Obvious particles, of all kinds, are removed by forceps. No oil or grease is to be applied. Next the burn is washed with a 1 per cent copper sulfate solution. In the chemical reaction copper phosphide is deposited. This is removed and the wound dressed. As there may be hidden particles of phosphorus, dry dressings are to be avoided.

With any or all of these methods, we come to a time when, so far as the burn area is concerned, grafting may follow. The weakness of the patient, however, may still be such as to make replacement by autografts of the necessary size impracticable. In some such instances, homografts are applied, in the expectation that they will last until the patient is strong enough to admit of autografts being taken. Where there is weakness, or where the state of the burned area is not satisfactory, some form of grafting should nevertheless proceed, preferably with pinch grafts, or with small isolated patches of epidermic graft. There is a spread of epithelialization while the healing continues. I have already mentioned that, where replacement can be made, injection of prontosil below the graft gives additional assurance of its success. It should be mentioned, also, that grafts on exposed parts, as on the face and hands, should not be exposed to direct sunlight, which will cause burns whose presence will not be signalled by the graft, since for a long time it is without sensitivity.

As I commented at the outset, this whole process leads up to a stage at which the special knowledge of grafts becomes of critical importance. Now that the whole picture has changed, and grafting is to come within a few weeks of the injury, the profession will adapt itself to the condition, and we will have fewer cases that present themselves months, or even years, after primary treatment has left the patient with masses of scar that contracts as it solidifies and that is destructive of function besides being disfiguring. In war conditions

cases are sent to centers where the proper treatment, with the necessary safeguards, has been organized. We shall find, later on, that the same principle will be applied within hospital organization. The régime under which every doctor attended his own burned patients is on the way out.

What form of graft or other replacement will be selected when the burn area is ready to receive cover will depend on the judgment of the operator and the condition of the patient. We need not here go into the considerations that influence selection as between epidermic, intermediate and full thickness grafts, or that favor pedicle flaps as against any of these. Nothing of that has been changed by war conditions.

An exception might be made in respect to the tiny pinch grafts, however, since they provide a means of dealing with extensive burns when the state of the patient prevents recourse to forms of grafting that would be preferable.

The pinch graft will not do for the face or hands, because of its lumpy appearance, but it does produce a satisfactory covering for even a very large defect on the arm, leg or other area not exposed, admitting freedom of functional motion under it when the epithelialization it promotes is complete.

Where adequate material to cover such a defect is not to be had, or the patient is too weak to allow of its being taken, tiny grafts, 2 to 6 mm. in diameter, are spaced at distances of rather less than 1 cm. About sixty of them will suffice for a defect area of the whole length of the arm.

The grafts should not be lifted from an area that can be drawn upon for large grafts. An area two to six inches square will supply them in unexpected quantity if taken only ¼ to ½ cm. or so apart. The hip offers a convenient patch. It is prudent to mark them before lifting, in blue, so that when transferred there is assurance of their being right side up.

So marked, a straight needle is engaged in the epithelial layer, the graft is raised in a small cone, and with a sharp scalpel the cone base is cut through at the skin level. It is removed at once, by the needle, to the granulation surface, which has been prepared with saline but not scraped or shaved. Two or more can co-operate in the work of lifting and applying the grafts.

These grafts, small as they are, include all the essential elements of the skin, the outer epidermis, the germinative epithelial stratum, and something of the papillae and other constituents of the corium. Placed carefully against the granulations, with the epithelial edges spread flatly on the surface, they become islands of epithelium from which proliferation proceeds in all directions, in time providing a skin covering for the burn area to which they are applied.

A hair dryer is used from time to time to dry the surface and coagulate the serum exuding from the granulations. The area on which the grafts are imposed is covered with tulle gras, and then by gauze wrung out in paraffin and flavine.

Dressings are removed for inspection in from three days to a week. If there are evidences of continuing mild infection in the defect, saline dressings are kept on. Otherwise tulle gras dressings are again applied.

To sum up, the experience gained in treatment of burns under stress of war conditions come down to this. Plasma and the sulfa compounds have completely displaced the tannic acid-silver treatment of burns, and the long delay incidental to that treatment has been replaced by skin grafting of all burn wounds within five or six weeks of the injury.

TISSUE GRAFTING*

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IN a very large part, plastic reparative surgery has to do with the replacement of tissues that have been lost. The losses are of various origins. They may be due to congenital maldevelopment, to disease or to trauma. They may be produced surgically, as part of some procedure in correction; or by excision in the treatment of disfiguring lupus, approachable cancer or disfiguring birthmarks; or by removal of contractile scar that tends to inhibit function and produce disfigurement. Even in taking a graft for replacement there is a loss which must be replaced.

The loss may be in any of the elements that go to make up the structure of the body, in bone, cartilage, fascia, tendons, nerves, vessels, membranes and skin. When, and at whatever stage, the loss becomes the subject of surgical concern, replacement is called for in the interests of health, function, esthetic betterment or of all three.

The body is itself the source from which the materials for replacement are drawn. The tissues so disposable are living entities, not inanimate compounds of fabrics. Their employment, to be effective, imperatively demands a precise knowledge of their composition, their characteristics and their behavior under stress of the new burden imposed upon them. Lack of such knowledge, or of the respect which is the tissue's due and which it inevitably commands, is reflected, later, in imperfection in the end result, or in failure. Thus bone, under certain conditions, will disintegrate or be absorbed, whereas in others it will live. Cartilage will support certain other tissues if its strength is accurately estimated, but not beyond its strength. Skin will do practically any thing that is demanded of it, but only if the conditions under which it will so respond are known, and if they have scrupulous attention at all stages of the replacement. Nerve and tendon replacements are similarly exacting.

Skin Losses and Replacements. If we are to develop these considerations, it will be convenient to begin with the tissue that is most frequently drawn upon in replacements, the skin. Always to be borne in mind is the fact that the skin is a flexible envelope covering every part of the body. It encloses all the soft tissues, without constricting them, and without influence upon their function. Both by its situation and its extent it is more exposed to trauma, and so to loss, than any other tissue. It carries, within its multiple strata, an active agent for the repair of its own losses, and for the covering of small areas that are denuded of its protection. When taken from one part of the body and transferred to another it will still live and will replace the lost covering of other tissues, thus assuring restoration of such functions as may have been inhibited through the loss of the flexible covering and the substitution of a covering that is constrictive.

Evidently, if there is to be reliance upon the usefulness of such a tissue in replacement procedures, the first consideration is certitude that the tissue so removed will live in the area to which it is transferred, and will have the non-constricting attributes of a true and natural covering of the tissues beneath it.

Upon what can that assurance be based? The answer to this question is to be sought in knowledge of those elements of the skin tissue which bear upon its capacity for continuing its own existence and, therefore, for remaining viable and fulfilling its function when removed to an area where the

problem is one of continuing or of restored activity as a living tissue.

There are two parts to the skin: To one of these a blood supply is necessary; to the other part there is no sustenance from vessels. It happens that the part presenting the lesser difficulty is toward the surface. A thin shaving of skin from the outer, epithelial layer will thrive upon the fluids present in the base upon which it is set. Where the underhalf of the skin is included, the requirements are entirely different and more complex. In the original locus, it has a full complement of arteries, veins, capillaries, lymphatics, nerve branchings and nerve endings, besides sweat and fat glands and hair follicles. Severance of the skin, by depriving these agencies of their normal association inherent in the continuity of the skin, tends to render them moribund, and unless there is restorative process by which the skin resumes infiltration by vessels, as arteries, veins, lymphatics, the skin dies. If it does, the attempted replacement goes for nothing and the repair fails.

Assurance that a graft or other skin replacement will live, therefore, varies with what is necessary to make it live. These necessities, being essentially different in the outer or epithelial strata and in the inner or corium layers, are basic to every selection of the type of replacement appropriate to the particular problem of repair.

That there will be such selection follows from what is common knowledge of the variety and the extent of the losses to which the skin covering is exposed. It may be so little as involves only a portion of an eyelid, the result of accident or of surgical intervention for the correction of a local anomaly. It may, on the other hand, as the consequences of a devastating burn, include most of the surface of the arm, leg, torso or abdomen. Between these extremes there is every degree of loss, in kind, quality and size, arising from congenital maldevelopment, trauma and disease. There is, again, the matter of disfigurement, having to do mostly with areas habitually exposed to

view. To maintain consistency in skin levels, in coloration, is as important in these cases as to provide covering. This is not true to the same extent in parts habitually covered. The point here is, no one type of skin replacement would serve in every instance; and since there must be selection the choice evidently must be governed by consideration for the area of repair and in part with reference to the shades of difference between the skin shaving of epithelium and the substantial body of full thickness skin.

This brings under review, for purposes of distinguishing between their uses, the principal varieties of skin replacement from which selection will be made. There is the epidermic graft which may be translucently thin; an epidermic graft with a trifle more substance, a graft which incorporated the outer, epithelial layers, the inner generative layer of epithelial cells, and the tops of the papillae within the corium, which this generative layer invests. Then there is the graft which includes all this last and strikes a little lower into the corium, called, descriptively, an intermediate graft. Last comes the use of full thickness skin which may be in the form of a free graft fully detached from its surroundings or of a flap which continues to be nourished by its own vessels, which are supplied through a pedicle that retains its normal circulation and continues it into the part constituting the replacement. The tiny pinch graft, in some situations the only available recourse, carries all of the epithelial elements and the corium, in varying proportions. Its value lies in the proliferation from the germinative layer which covers the interstices between the main layers of skin.

Importance of the Time Element. While selection of one or more of these types of skin cover must be made in any and all conditions in which repair is to be undertaken, it is important that replacement be effected as soon as practicable after the loss has been sustained. If that is done, the tissues that are covered continue in normal function. Where, on the other hand, as so

often happens with burns, mistaken concern for the welfare of the patient leads to leaving in place skin whose structure has been materially affected by the injury, the connective fibers that make up the corium lose their flexible and elastic qualities and the skin becomes contractile as the tissue develops into scar. In these conditions, free functioning of the tissues under the skin cover is progressively restricted and disfigurement and distortion are inevitable. Notably this is true in areas where function depends on the action of joints and tendons. Where the loss is of sound skin, displaced by wound or abrasion, but available for replacement, it can be returned over an open wound during a short period after the injury. Opinions vary as to the lapse of time within which this will be successful. I find four hours fairly safe.

Epidermic Graft. The selection of a replacement naturally begins with consideration of what is to be achieved and what should be avoided. For example, if we have to deal with a cul-de-sac to be furnished with a simulated eyeball, the first problem is the lining of the cavity after a surface has been prepared. This surface will include the walls of the cavity and probably also the inner aspect of the upper and lower eyelids. The lining of the upper eyelid must be very thin, as otherwise its motion would be impeded. The lining of the cavity must have the utmost certainty of "take," because of the situation and configuration. There must be a pouch within which the prosthesis will be comfortably and steadily held; and there must not be, as sequel to the replacement, growth of hair or rancid emanations.

Only the thin epidermic graft meets all these requirements, since it consists of a mere shaving from the epithelial layers of the skin, is in no way dependent on vessels within it, is readily nourished by the fluids present in the base upon which it is imposed, and can easily be given the form desired by the simple expedient of wrapping it around a mould of stent, outer surface next to the mould. To these positive advantages is added the important negative one that, since the sweat glands, hair follicles and sebaceous glands all lie deeper within the skin, none are transferred to the new location where such emanations would be annoying.

The controlling factor in all this, the one by which the epidermic graft is distinguished from all other skin replacements, is the ability of the epithelial cells to derive from the all pervasive lymph fluid the sustenance they need for continued life.

To be carefully noted, however, is the fact that so very thin a graft has a tendency to shrink. It must, therefore, be maintained in place by immobilization over what may seem a long period after the "take" is assured, until there is complete organization between the graft tissues and those of the base.

Also, there is the problem of coloration. In the undivided skin there are some wandering dark cells in the epithelial layer. These escape downward. In the epidermic graft, either they escape outward, or, if they remain, give a melanotic tinge to the graft. This may result in a prune juice color which will constitute a disfigurement if there is a patch of it in an area of clear skin in an exposed place. Use of the epidermic graft on the face is, therefore, contraindicated, except in the case in which a general darkening of the skin having been produced, as by some orders of burns, it might conform to the rest. Again, being as thin as it is, a patch of this graft would fall below the general surface level of the denser skin. Such a depression would be a disfigurement.

Not all replacements are on the face, however, and the further and often determinative advantage of this graft is that it can be taken in effectively unlimited amounts, and, if necessary, from more than one area. The repair is not prejudiced if the edges overlap in the procedure of replacement. Moreover, when this graft is lifted, the epithelial surface from which it was taken immediately begins the accomplishment of its own repair.

Intermediate Free Skin Graft. While the thin epidermic graft will provide a cover for a very small or a very large defect, it leaves something to be desired where either coloration or density of substance demands consideration.

The lowest layer of the epidermis consists of the germinative epithelial cells. These cells work their way to the surface, becoming less and less potent as they go. Most of the seven or eight stratifications are flat, and lie horizontal to the surface. The germinative layer is an exception. A basal membrane separates it from the corium, but the papillae, the monticules of fine connective tissue in which the vessels of the corium end, push their way into this stratum and render its floor irregular. A graft taken deeply enough to include part of the germinative layer must, therefore, include the tips of these papillae, and to that extent, would not be an entirely epidermic graft. It would, on the other hand, have within it all the overlying strata and something of the lowest lying and in many ways the most important.

Experience has demonstrated that this graft, intermediate in thickness between the epidermic and the free full thickness grafts, is equipped to derive from the lymph of the sera of the defect the nutriment essential to the continued life of the cells. So far is this true that the intermediate graft does not, ordinarily, require the aid of sutures in effecting coaptation with the skin edges of the defect on which it is applied. So natural is the union that often there is so little trace of eventual scar that it is difficult to define the area of replacement. It may be difficult even to identify the replacement, and that fact illustrates the second advantage of this graft, which is that when the whole depth of the epidermis is taken the surface coloration is retained in the new situation. Since it is known that skin coloration is influenced by the patency of the capillaries, it may well be that the inclusion of the tops of the papillae conduces to the desired result of

rendering the graft indistinguishable from its surroundings.

By the employment of a calibrated instrument known as the dermatome the thickness of these grafts can be more or less accurately adjusted, the effusion from the vessels of the papillae need be little more than pinpoints, and recuperation of the donor area presents no serious problems.

With so serviceable a material at hand, it is obvious that recourse to it will be frequent. One might, for example, find in the shaving of epidermis an adequate cover for a forearm denuded of its skin, over a considerable part of its surface. But the covering of that part of the arm would be visibly different from the rest, both in consistency and, as time went on, in coloration, the replacement becoming progressively darker. With the intermediate graft, on the contrary, it might be difficult to recognize any difference whatever.

Again, in replacement on an exposed area, such as the back of the hand, rather more body to the cover is demanded than the thin epidermic graft would supply, apart altogether from esthetic considerations. The retention of color and the facility of "take" combined with the density suited to the functional need, exemplify the utility of this type of graft in one situation and indicate its superior usefulness in many.

Free Full Thickness Skin Grafts. This denser and better appearing graft does not, however, meet the requirement in all cases. For example, if it is the palm of the hand that needs a new cover, weight must be given to the obvious fact that the skin of the palm is denser than almost anywhere else on the body, and that the best repair would be in kind. Similarly if a lupus condition calls for removal of a section of the skin of the face, the material of replacement chosen must be such as will harmonize with the adjacent facial area in color, thickness, texture and in everything least likely to attract attention after the repair is complete.

Only skin of full thickness will meet this test. When that decision has been reached, there may still be a choice of methods. The replacement may be brought by means of a pedicle flap, or it may come as a free full thickness graft brought direct to the defect from a distant part of the body.

The difficulty about utilizing a flap from an adjacent area is that it tends to produce one disfigurement in getting rid of another.

The alternative method has so many features making it preferable that no effort is too great if its application will increase the certainty of success.

There is no better index of the progress in this sort of surgery than the improvement that has been made from the time when a doubtful 50 per cent success attended transfer of full thickness free skin, to that in which, barring some unpredictable and intractable variation in skin or body chemistry, success is practically uniform.

In keeping with what has been said and respecting the tissue of which we demand this high service, it will be convenient to mention here some precautions it is important to observe.

One considers first the patient. If his skin is not in a healthy state, if there are pimples, boils, etc., suggesting complications even at a distant stage, if an abnormal platelet count warns of possible oozing, intractable bleeding, blood clots, etc., there should be postponement until these conditions have been cleared up.

Next one considers the state of the defect. If granulations are painful, if they are grayish, if there is exudation of pus, if there is no epithelial response at the wound edges, there should be no grafting until all this has been righted.

Then as to the graft itself. One should seek to be satisfied that the oxygen and sulfur content of the skin in the donor area is normal. For better assurance as to this, the area to be incised is cleansed the night before the operation with soap and water, then with sulfuric ether, with light soap and water wash in the theatre. No antiseptics are to be applied to the skin pre-liminary to incision. Incision is to be with a sharp knife and made with no bevelling of edges or jagged lines of incision and no heavy handling of the graft or squeezing with forceps. The under tissues and lower part of the corium should be sheared off.

At the defect, the graft should be imposed only on a dry base, always with size A silk, as a precaution against infection. Approximation should be even and thorough, with no slack in the graft, but rather slight tension. The graft is immobilized by bandage, with pressure of a kind and degree suited to the actual case.

These precautions are indicated, primarily, by the knowledge that infection is the one enemy to be feared in this order of replacement, and secondly that the skin we are here dealing with is in two wholly dissimilar parts. The epidermis is not now detached and left to assimilate its nutriment from the lymph that is directly in contact with it. The epidermis now rests upon the corium which is its natural complement and is dependent upon that body. The corium, on its part, is not vitalized by the lymph. Cut off from their accustomed communications, the vessels that permeate the corium must have that communication restored, with the help of branching of vessels in the base.

We have seen that the epidermic and intermediate grafts do not need too careful an adjustment to the wound edges. They effect their own epithelial approximation. It is otherwise with the fibers of connective tissue that compose the corium. Apposition of graft edges of this composition to the similar edges of the defect depends on exactness of pattern and upon the most delicate suturing, if scar and unevenness are to be averted in the final state.

An accurate pattern of the defect is best secured from lint saturated in the blood of the defect. Accurate reproduction of the pattern requires a knife that has none of the imperfections which produce jagged edges. A fractured razor blade produces a useful instrument. Accurate suturing is not possible if the edges of the graft or of the

defect are bevelled or uneven. Hence the incision must be vertically straight.

The graft is not to be bathed in saline or other cleansing solution. It is left in the sera of exudation caused by its excision and benefits by two qualities of such sera, one, resistance to infection, which is the ever present enemy, the other rendering the graft adherent to the defect base during the first twenty-four hours, the time needed for the restorative process to set in. The restoration process is facilitated by eliminating the coarser connective tissues at the bottom of the graft.

The skin, in its now weakened condition, is transferred to the defect by means of threads diagonally spaced. These will serve as anchor sutures in the new situation. From these bases the suturing proceeds, with the utmost discrimination, until the defect is regularly and smoothly covered. The donor area is covered by epidermic skin graft.

Every precaution having been taken, in relation both to the graft and the base upon which it is imposed, attention is henceforth concentrated on facilitating its revival. This depends on return of vascular circulation within the corium section. One reason for having the graft slightly on tension, rather than loosely covering the defect, is to ensure that the contact with the base is complete and uniform. This contact, at first established by the sera, is maintained by pressure. That pressure must be nicely guaged. With too little pressure, the two bodies tend to separate and the essential communication between their vessels is lost. With too much, the branchings which begin from the arteries in the base do not penetrate. In either case, the vascular supply requisite to restoration of the corium does not reach the graft and it fails. This is illustrated when, because of incomplete contact with the base, the graft dies in those spots where contact and even pressure are not maintained. That the pressure to be applied closely approximates the normal blood pressure in the arterial flow has been confirmed in practice, but there is nothing absolute about the amount and there is some room for variation.

Whatever form of pressure bandage is applied, it may be removed for inspection from the second to the tenth day. A rose color in the graft is indication that life is returning to the moribund cells of the corium. Close observation suggests that this begins in the graft truncated as described, sooner than used to be looked for before that refinement was adopted. White patches bespeak failure, and if they persist, should be removed and subsequently replaced. After cleansing, dressings are replaced, and examination is continued by further removal and replacement until recovery is complete. Inflated rubber bags may be utilized to maintain consistent pressure. In some instances restoration will be promoted if the graft is held in position by a mold, and this in turn by adhesive tape.

In this postoperative period, solicitous concern is to be shown for any suggestion of a developing infection. Should such appear, the fact that everything possible has been done to avert it and has somehow proved ineffective in doing so makes instant attention imperative. Infection is the one serious threat to the success of this kind of skin replacement. Elimination of this danger, in successively greater degree, has made possible the use of the free full thickness skin graft in a greater variety of situations and in ever expanding amounts.

In the process of restoration, the vessels precede the nerves. Sensory return, being the latest, indicates completion of the repair.

Before that stage is reached, surface coloration asserts itself. While the graft has been taken from a covered area and has not the same coloration as the skin of parts exposed to sun, light and currents of air, the capillaries which govern in this matter and which are provided with a mechanism of their own, will respond, in time, to the stimulation of exposure, and will accommodate the coloration to the esthetic requirement of the adjacent area that has

been so stimulated habitually. In exceptional instances, as when the cover for a skin loss on the nose is taken from like material back of the ear, there is no delay for this adjustment. Ordinarily, the sites selected for the donor area are the abdomen, the non-hairy parts on the inner side of the left thigh, the outer side of the right thigh, or the inner side of either arm. There must be full muscular relaxation. Otherwise, as when there is bellying of the adductor longus on the thigh, or in the groove between the deltoid and triceps on the inner side of the arm, there is an uneven surface and the graft cannot be evenly cut.

Precision in Raising Grafts. There is today no reason why the general surgeon should not undertake these grafting processes, since he·has at his command instruments to supplement the use of the knife. There is the Blair graft knife, with sucker or board; the Humby roller knife and board; and the Padgett dermatome, an entirely mechanical machine to supplement the preference for a sharp knife and board. In this latter method the graft is raised by the to-and-fro motion of the knife, of the surgeon's selection, laid flat on the skin surface.

Pinch Grafts. While very often the problem is to procure a large enough graft, a determination which may decide the selection of an intermediate rather than a full thickness graft, there are situations in which the recourse must be to numbers of the very smallest graft.

An example is that of an arm or leg on which there has been extensive skin loss, as from a burn, and when, because of the patient's condition or for lack of donor area of suitable dimensions, the pinch graft can be utilized to give a stable cover.

Tiny as it is, being only from 2 to 6 mm. in diameter, this graft incorporates the outer layers of the epidermis, the inner or germinative layer, and a section of the corium. Placed about a centimeter apart on a granulating surface, the grafts "take" in as little as forty-eight hours and dressings are removed within a week. From the edges an epithelial proliferation spreads out in all directions, gradually supplying the intervening spaces with a rough but stable surface covering. On the face, or other exposed area, such covering would be unsightly and the graft is not suited to be employed there.

When it is used at all it is employed in considerable numbers. These should not be taken haphazardly from an area that would provide other forms of graft and which would be spoiled for that purpose by the excisions. A small hidden area, as on the thigh or the iliac crest, will spare an abundant supply when judiciously spaced.

It is well to mark in blue the spots of surface it is intended to raise, so that they can be later identified as right side up.

The graft is lifted to a cone by means of a needle, and detached with a sharp scalpel, at the base of the cone and at skin level. These little islands have a periphery of epithelium. Each is removed to the granulating surface of the defect by the needle and is carefully spread. They are placed at distances of rather less than a centimeter and are kept in place by lint immersed in oil and balsam, with covering of cotton wool wrung out in flavine, 1 to 100 solution, and Dunlop rubber pads a half centimeter in thickness, the whole immobilized with adhesive. Redressing after inspection is lighter. If there is infection present when the dressing is removed, the parts are washed with salt solution or 5 per cent magnesium sulfate.

Pedicle Flaps. In all skin replacements the end factor is the same. The imposed tissue becomes incorporated with the tissue of the base. The agent of this organization is the blood supply. In the case of free grafts, the supply is by vascular infiltration from below. The process of restoration is, for this reason, least doubtful with the thinnest grafts and increasingly doubtful as the grafts are thicker. The very thin epidermic graft makes no demand, and will thrive on the nourishment afforded by the lymph in the tissue spaces. The intermediate graft requires vascular support, but its demand

is not heavy upon the blood available at the capillaries in the tissues of the base. When we come to the next stage, the so-called "full thickness" graft, it is no longer safe to count upon the supply from the base being adequate to the purpose. If the subcutaneous fat is left on the graft, the incorporation does not take place. The capillary blood supply is not capable of infiltration through the fat and into the corium. From the recognition of this it was a short step to facilitate reorganization by excising part of the lowest stratum of the fibers of the corium, so that "full" thickness became a misnomer. It follows that when there is evident need for a replacement that includes the subcutaneous fat, none of these forms of graft will serve. And there are conditions, such as the provision of a cushion over nerves, tendons and vessels, in which a cover denser than any of the grafts is essential to satisfactory repair.

The obvious reasoning then is that replacement skin that has its own blood supply has a better chance of survival. This is the condition that determines the selection of a pedicle flap. The blood supply from the pedicle helps sustain the life of the flap while new supplies are finding their way in from the base and from the edges. At the last, the pedicle is cut and the auxiliary blood supply withdrawn.

It follows from this recognition of the importance of an intrinsic blood supply that certain precautions are necessary. Care must be taken so to locate the pedicle that it encloses one or more vessels. The outline of the flap will not be by incision lines that cut across the prolongation of the vessels in the pedicle. If the flap is brought to place at once, it may be found that the inflow is too strong, and that, since the mechanism of return does not exist at the borders of the flap, there will be choking at the suture lines, followed by swelling, with danger to the life of the flap. The rate of inflow can be reduced by judicious application of pressure at the pedicle.

Delayed Flap. When a skin flap is brought to place and sutured as soon as it is lifted, the deposit of fibrins incidental to defensive exudation tends to interpose a barrier against apposition of the skin edges and so leaves a line of scar. The tendency with scar is to become contractile. Of itself, and by its effects it contravenes the rule of plastic surgery against producing one disfigurement while correcting another. It is decidedly desirable, therefore, to bring the flap to the area of repair in such condition that all mishaps may be avoided, if that can be done

By returning the flap to the bed from which it has been raised, much of this is accomplished. Resentment to insult is manifested, but at the expense of the graft tissues only. Its edges, when the time comes to lift it again, can be made such as will favor healing with the minimum of scar at the line of suture. What has gone on within the flap during the delay has made it more dependable. If left too long, there is a tendency to induration; but if the second lifting is within the week, this problem does not arise.

It may be preferable, in given conditions, to have the flap supported by pedicles at both ends. Or it might be found expedient to cover a defect on the hand by means of a pocket of skin of the abdomen, conserving the blood supply from two or more directions. In these, as in the simpler forms, the reliability of the flap is improved by the "delay."

Tubed Pedicle Flap. Whether it is brought to the defect immediately or after "delay," the pedicle flap is limited in location to the adjacency of the defect, and in extent to proportions inadequate to many replacements that must be made.

The amount required, by almost any demand, can be obtained, and at a distance from the defect to be covered, by recourse to a flap of two pedicles, lifted on the abdomen or other extensive skin area. The opposite edges are turned under, apposed and sutured, thus forming a tube. A continuing blood supply, from two directions, is thus assured. The denuded area is covered by skin graft, leaving the tubed skin

free to be used or discarded when transferred to a distance from its original site.

Although such a flap may be brought from the abdomen to the face or neck, the principle of a supporting blood supply is maintained; the migration, which is effected by raising the distal pedicle to a position nearer to the defect than the proximal pedicle, provides for blood supply from two pedicles until the very last stage, when there is still blood supply from one pedicle. It may be desirable to have the last migration effected by attachment of the pedicle to the arm or thumb, thus providing greater freedom of movement when the last distal pedicle is detached at the time of repair.

With such preparation, the flap is in the best practical condition, is ready for immediate application, has left behind it those complications that in a newly raised flap would tend to inhibit reorganization, either at the borders or with the tissues below.

Replacement material of this consistency, and which can be taken in amounts to meet any requirement, is adapted not merely to use in a great variety of conditions but can be relied upon to justify the creation of surgical defects that would not be warranted if the means of cover were not assured. Over deep defects, where more than one thickness of cover is necessary, it can be adapted to the situation with a minimum of attendant inconvenience.

Advancement and Transposition. The elastic property of the skin conduces to the covering of certain defects without recourse to pedicles. The adjacent skin is undermined to a depth consistent with the stretching that is to follow, and then advanced to apposition with the skin border beyond the defect. In some instances advancement may be accompanied by a rotation. This is notably true where there are multiple abrasions of the skin surface, rather than areas of considerable loss, which could be covered by a single replacement. These abrasion losses are apt to be of irregular contour and some excision may be necessary to produce suitable suture edges.

The initial skin advancements, or some of them, may prove inadequate, but the stretched skin acquires, in time, the increase of elasticity that warrants its being advanced or rotated after fresh undermining. Since multiple abrasions offer the prospect of multiple scars, the ultimate of surgical precaution against more than the minimum visible scar appearing in the end result must be observed at all stages. The evident advantage is that the covering of defects is by the skin natural to the area, which does regain its normal texture after these disturbances.

The same elastic property of the skin can be brought into convenient requisition when some change in existing alignment is desired, notably in the oral and orbital regions. Skin on stretch, exerting a pull upon other skin to which it is attached, gives results that would not be produced by mere overlay replacement. By shifting the direction of pairs of triangular small flaps, a line is raised here and lowered there, or shortened in one part and lengthened in the other, achieving the correction desired. This manipulation of flaps outlined by incisions resembling the letter z is practicable in great variety.

The same principle is applied in eliminating areas of scar. Long scars resulting from burns, as on the neck, in some cases can be got rid of by simple excision, the defect being covered from the wound edges by skin advancement. Mere eradication of the scar and direct apposition do not suffice. Better suture lines and a more desirable ultimate form are assured by the creation of triangular defects beyond the scar areas, into which are fitted triangular flaps of skin advanced from the opposite sides. In the patterning of such flaps, and of the receiving angles, there must be scrupulous regard for the symmetrical requirement, as otherwise the approximation will be irregular and the end scar undesirable. With the opposing angulations patterned in strict conformity one to the other, the best result is assured.

Depressions. The atrophy of facial muscles and other conditions that may be met with result in disfiguring depressions. To effect a continuous surface level, small amounts of skin may be introduced in a single layer or in rolls according to need. As the presence of a hard tissue immediately below the surface would be readily detected, the epidermic surface is removed, and, to the same purpose, the inner, softer part of what remains is kept uppermost, next the undersurface of the cover skin. Error in this adjustment will become evident to sight and touch.

Variants of these rolls of skin may be found useful in filling a small depression on the nasal dorsum, or in lending firmness to a columella or otherwise improving its position.

Mucous Membrane in Replacement. Like the exterior skin cover, the mucous membrane of the cavities is a serviceable material of plastic repair. Either as a free graft or with one of its borders undisturbed it is dependable. Its use on exposed areas is limited by its color. It is the only suitable replacement for loss on the vermilion border of the lips. These, being extensions of the membrane of the mouth, cannot be satisfactorily replaced except by that membrane. On the other hand it is too red to replace loss in a visible area of the ocular conjunctiva. For this a membrane of scarcely perceptible tinge may be had from the middle turbinate.

Where there is a channel to be constructed to replace one injured or absent for other reason, the membrane has peculiar value. Unlike the epidermic graft, it is organically complete. It reorganizes with other tissues, therefore, on a sounder basis. It has practically equal assurance of "take." In corrective procedures for hypospadias, for restoration of occluded lacrimal drainage, and the like, it is the material of choice.

Other Materials of Plastic Repair. While the skin is the tissue most drawn upon, and of most various application in reparative surgery, all the other tissues may be brought into service at need. Cartilage and bone have the lead in this service, but fat, fascia, nerves, vessels, tendons, muscle strands, even the nails, respond when drawn upon.

Cartilage, which meets the demand for a material firm enough to support other tissues in fixed relations, is available in any quantity required. It is present in the nose in small but often sufficient amount which may be supplemented from the ear. The costal crest can be drawn upon for larger amounts and of a density adapted to heavier burdens. Being pliable, it is susceptible of adjustment to new forms. It can be shaped to fit a new situation. It is welcomed as a living tissue when newly inserted among other tissues, and so does not promote inflammations antecedent to expulsion. Continuing as a living entity, it does not deteriorate. Excess remaining after a repair procedure lives when implanted under the skin of the chest. Recently, such remainders have been found to retain their quality when kept for long periods in solution. There is a tendency to bend, but this is usually due, when it is observed, to faulty estimation of the quantity suited to bear the strain imposed. As the cartilage and its perichondrium react unequally to the new surroundings, the shape of the transplant will alter if the perichondrium is left in place. It therefore is removed except where needed for support, as over a sharp angle, or for suturing, as to the periosteum of the nasal spine.

In nasal readjustments, in which the cartilaginous septum and the alar cartilages are important elements of repair, the local supply frequently suffices for improvement of form and for filling incidental small bridge depressions. If there is need to replace the cartilaginous septum fully, it becomes a question whether to invade the costal crest, involving serious surgery, or to turn to bone for the necessary support.

Bone as Plastic Material. The guiding principle in relation to bone implant is that it should be, to the utmost extent practicable, in contact with bone. In the case of

an overlay of other bone, in which union after fracture is imperfect, the contact is ample. A bone graft mortised to bone to effect mandibular repair similarly fulfills the requirement. But where, as in supplying a substitute for the nasal septum, bone is employed, contact of bone with bone at both ends and on the floor of the nose is essential if the process of absorption and consequent disintegration is to be averted.

Bone from the iliac crest offers an acceptable alternative to the cartilage of the costal crest. Bone from the same area is peculiarly adapted by its curved conformation and the ease with which it can be given shape to replacement of losses on the skull. The iliac crest is approached by a curved incision, the periosteum reflected over the requisite area, and a thin plate of bone removed. The rest of the problem is concern for the promotion of osteogenesis in the new situation.

Tendons, Fascia, Nerves, etc. Loss of function in hands or feet, whatever other aspects may be present, is associated with constriction, displacement, or inadequacy, including loss, of the tendons. After they are exposed and freed, readjustment may involve lengthening, splicing of parts, or grafting, for which other tendons are drawn upon for the materials of replacement.

Fascia, the sheath of the muscle it invests in nature, is of great tensile strength in the direction of its length. It is invaluable in the mechanical correction of the mouth distortion characteristic of unilateral facial paralysis, and as suture material in the repair of hernia. Packed or in rolls, it is usefully inserted beneath the skin to eliminate depressions, alternative to rolls of skin. Fat is also available for this purpose, but whether it remains or is absorbed depends on body conditions in the individual which defy estimation.

In rare instances, an area of skin and its attachments may be transported for replacement at a short distance, attached to a blood vessel, the whole being carried through a channel fashioned under the intervening skin. Esser calls them island artery grafts.

Interrupted innervation, whose causation often is traumatic, may be restored by the introduction of nerve substance in the form of grafts. A considerable literature has been devoted to the use of this expedient in respect of the facial nerve.

An alternative to that procedure brings in the muscles as plastic material. The fibers of the temporal muscle, being so constituted as to have the same direction as their vessels and nerves, are turned on pedicles to overlie the muscles of the orbit, cheek and mouth, from which innervation by the facial nerve has been lost. The effect of the overlay is to reanimate these muscles.

Readjustment of muscle fibers is practicable for the correction or improvement of other conditions. Always it is a pedicle device, never a free transfer.

It has been a surprise to many that the nails are a source of plastic repair. The nail, however, is only epidermis of unusual thickness, the other pertinent matter being that it depends for life and growth upon its contact at the nail root. Given these conditions, loss in one nail can be replaced by implanting at its root the proper material drawn from another nail. Time and attention do the rest.

Foreign Bodies Not Plastic Material. The tissues do not tolerate foreign bodies but start at once upon the effort to expel them. Only disappointment meets the tentative hope that an exception will be made for gold, silver, ivory or any other substance. The presence of one of them merely makes certain the ultimate break down of the repair. For two reasons, paraffin is the worst. First is its infiltration of adjacent tissue with particles so diffused as to defy removal when the inevitable inflammation is declared. Second is the inexplicable refusal of many to receive the warning of this unvaried experience and be guided by it.

TUMORS OF THE NECK*

SPECIAL REFERENCE TO CONGENITAL CYSTS AND FISTULAS

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NO other part of the body, with the exception of the abdomen, has so great a variety of inflammatory swellings and new growths as the neck. In its complex embryologic evolution, there are many developmental anomalies. Its

TABLE I
TUMORS OF THE NECK

I. Inflammatory:
  1. Abscess, furunculosis and carbuncle, Ludwig's angina, woody phlegmon, etc. Also anthrax, actinomycosis, echinococcic cyst, etc.
  2. Cervical lymphadenitis (acute and chronic)
  3. Salivary gland inflammations (acute and chronic)
  4. Tuberculosis, syphilis, Hodgkin's disease, leukemia, etc.
II. Embryologic anomalies:
  1. Tumors of the thyroglossal tract
  2. Lateral cysts, of branchial or thymic duct origin
  3. Cystic hygroma
  4. Angioma and lymphagioma
  5. Dermoids and teratoma
III. Neoplastic:
  A. Benign:
    1. Lipoma and steatoma
    2. Fibroma, neurofibroma, ganglioneuroma, etc.
    3. Osteoma and chondroma
  B. Malignant:
    1. Epithelioma and carcinoma
    2. Sarcoma and lymphosarcoma
IV. Tumors of special organs:
  1. Thyroid gland: All goiters, hyperplastic and nodular, toxic and nontoxic, benign and malignant; aberrant thyroid growths; parathyroid tumors
  2. Salivary glands: Cysts and mixed tumors; Mikulicz's syndrome, etc.
  3. Carotid body tumors
  4. Aneurysm of the carotid and subclavian arteries
  5. Tumors of the larynx
  6. Tumors of the esophagus

anatomy is important, with its definite bony and muscular landmarks; and its complicated planes and partitions of fascia

and muscles, enclosing a field overcrowded with vital organs, great vessels, nerves, lymphatics, ducts, etc.

In an attempt to give a clinical classification of neck tumors, the word "tumor" is used to describe not only true neoplasms, but includes morbid swellings as well. (Table I.)

The diagnosis of neck tumors is not difficult, as a rule, if history, physical examination, and laboratory data are carefully weighed. On occasion, the differentiation does have to wait until sections can be obtained and microscopic study made before a diagnosis can be given. And sometimes the histopathology may be so altered from hemorrhage, pressure, inflammation, or malignant degeneration as to make difficult or impossible a satisfactory report as to the origin and structure of a particular specimen. Occasionally, too, the clinical behavior in a given case may be in conflict with the pathologic diagnosis made at the time of operation. This is especially true of certain goiters, aberrant thyroid growths and salivary gland tumors, pronounced malignant by the pathologist, yet running a benign clinical course subsequently. On the other hand, the benign microscopic appearance of most carotid body tumors may be followed by definite malignancy, after incomplete surgical removal. The pathologist is not so apt, as is the surgeon, to regard these rare growths as malignant. However, all of them should be considered as malignant or potentially so.

Parenthetically, it might not be amiss here, to state that the high mortality and morbidity which follow ligation of the

carotid vessels, necessary in fully one-half of the cases for complete removal of these uncommon growths, can be lessened materially by appropriate preliminary treatment. Every suspected case should have systematic compression of the common carotid artery against the large anterior tubercle of the transverse process of the sixth cervical vertebra several times a day for a few weeks, in order to develop collateral circulation in the brain on the affected side, to avert the danger of death from cerebral anemia and softening, and to avoid the risk of the serious paralyses often present in the patients fortunate enough to recover from operation. This treatment should be kept up until faintness or actual fainting no longer occur when prolonged pressure is made on the common carotid artery.

Extensive neck dissection for tuberculous cervical adenitis was not an uncommon procedure some years ago; while today not only the operation but the disease itself is relatively rare. Better attention to the prophylactic care of mouth and teeth and nose and throat, and an improved milk supply, account for a decline in the frequency of cervical tuberculosis.

Probably more thyroid operations are performed today than ever before. Increased knowledge of the anatomy, physiology, biochemistry, and pathology of this gland, a greatly improved surgical technic, a low operative mortality and the quick relief of troublesome symptoms, all combine to give the thyroid first place in the field of neck surgery.

All surgeons have experienced the difficult, delicate, and often arduous task of extirpating certain neck tumors. Occasionally, however, an agreeable surprise will be met where real trouble was anticipated. The case of a young boy is recalled with a large growth at the angle of the jaw, extending upward and inward so as to displace the tonsil and crowd forward the lateral wall of the pharynx. A preoperative diagnosis of lymphosarcoma was considered and a serious operation was ex-

pected. The tumor turned out to be a lipoblastoma which could be shelled out without any difficulty. Another large submaxillary growth, pushing the floor of the mouth and the tongue upward, said by an oral surgeon who had done a biopsy to be a mixed salivary tumor, also proved to be a deep subfascial, embryonal lipoma, the removal of which was accomplished with the greatest of ease. The planned extirpation of a suspected new growth may turn out to be merely the incision and drainage of a deep abscess.

Among the important and serious infections of the neck, demanding the highest surgical skill, are Ludwig's angina, a streptococcal cellulitis of the floor of the mouth and the neck, perivascular infection of the carotid sheath, and diffuse cervical cellulitis. It is being impressed upon us that in the future the management of these virulent infections is going to be influenced favorably by the use of the sulfonamide derivatives.

CONGENITAL CYSTS AND FISTULAS OF THE NECK

The principles and problems concerned in the treatment of congenital neck cysts, sinuses, and fistulas have been understood and taught for many years. Certain operations have become more or less standardized. In spite of this, the percentage of recurrences and failures in the treatment of these lesions is altogether too high even today. Palliative treatment or incomplete operation invites embarrassment and failure; radical excision promises almost uniform success.

Many interesting articles have been written about the embryology and the factors underlying the development of cysts, sinuses, and fistulas of the neck. Probably the most outstanding and generally accepted contribution to this subject, still a controversial one, is the work of Wenglowski, published in 1912. The theories and principles, as set forth by Wenglowski, were given critical examination by Klingenstein and Colp, in 1925, and

by Herbert Willy Meyer, in 1932. Meyer, in elaborate detail, has reviewed and interpreted the whole intricate problem so

chair" theorist who airs his views on neck embryology. He has profound respect for Wenglowski, who worked for five years on

FIG. 1. Case 1. Result three and one-half years after second operation, showing keloid formation in scar.

clearly and logically as to bring order out of confusion, particularly as relates to the branchial and lateral cervical cysts and fistulas. He has called attention to the fact that the beginning of the development of the branchial apparatus in the human embryo takes place in the second half of the first month, and in the course of the second month, sometimes even in the first half, the branchial apparatus disappears completely; that it belongs more to the head than the neck; that the lower border of the hyoid bone forms the lower limit of any branchial remains and any anomalies below this level can have no genetic relationship to the branchial system. Thus any lateral cyst or sinus above the hyoid line might be of branchial origin, any below must of necessity arise from other sources. "This means that almost all congenital anomalies of the neck are not the result of the branchial apparatus, but come from other factors, even though they may have originated from this apparatus."

Bailey has small opinion of the "arm-

the branchial apparatus, examining no fewer than seventy-five embryos and 246 cadavers, before profounding his theory. He disagrees with him, however, in his opinion that no branchial remains are to be found below the hyoid level. He mentions cervical auricles and cites the case of a persistent branchial cartilage situated in the lower part of the neck, exactly where a fistula usually opens, as evidence of the incorrectness of Wenglowski's hypothesis. He says "even if I were qualified to do so, it is not my desire to become involved in the intricacies of the embryology of this difficult region. My object has been to approach the subject from the purely clinical side, but I have fostered a hope that by dropping a morsel of truth from the patient's neck into the seething cauldron of controversial cervical embryology, perchance I might help to clarify what is to be served to the student tomorrow."

Meeker objects to the term "branchiogenetic" and says that the human embryo at any stage does not possess structures

that could properly be considered as precursors of congenital cysts of the neck. Many such cysts, particularly those near the angle of the jaw, are considered to be of tonsillar origin, as they are characterized by an abundance of lymphoid tissue in the walls lined by squamous epithelium.

If one accepts Wenglowski's dictum, the cysts and fistulas occurring between the lower hyoid level and the suprasternal notch, along the inner border of the sternomastoid muscle, usually are considered to have arisen from vestigial remains of the pharyngothymic ducts. As a rule they are lined with stratified epithelium with endothelial characteristics: without hair, papillae, sweat, or sebaceous glands. Ordinarily, the thymus canals disappear early and completely, but they may persist throughout life, and, as already stated, thymus rests may form cysts or fistulas. The course of the ducts is from the palatopharyngeal area slightly downward across the space between the ear and the angle of the jaw, then downward and forward and medially, close to the thyroid gland and medial to the margin of the sternomastoid muscle, down to the sternum where they pass into the thymus gland.

Lateral cervical fistulas are present at birth or develop, as a rule, early in life. They may be *complete, internal incomplete,* or *external incomplete.* Branchial and lateral cysts form later in life.

Cysts of the neck give rise to but few symptoms, other than the deformity of the tumor, unless infection complicates the picture. After operation (complete excision), healing has been prompt and permanent in all of our cases, seventeen in number, with but a single exception.

CASE REPORTS

CASE I. Sylvia B., age seven, was operated upon at three and one-half years of age, for a sublingual cyst. At age five, she developed a swelling in the left submaxillary region, near the angle of the jaw, which disappeared after roentgenotherapy. Early in October, 1937, there appeared a painless, cystic tumor in the

same area that had been treated two years earlier. On October 16, 1937, the cyst was incised by another physician and clear serous fluid evacuated. Active infection of the cyst followed this procedure. She came under our care and was operated upon, October 21, 1937. An oblique incision was made over the area of tumefaction. A small, broken down cyst was dissected from the region of submaxillary salivary gland and upward and outward toward the lower pole of the parotid gland, and posteriorly along the sheath of the great vessels. It was thought at the time that the entire cyst wall had been removed.

The pathologist said that specimen was lined with purulent granulation tissue, with foreign body reaction. However, he was unable to state the nature and origin of the cyst, owing to the absence of a lining epithelium.

The wound healed, but the cyst recurred, and when the patient was readmitted to the hospital, in October, 1938, it was larger than at the previous admission one year earlier. The second operation was performed on October 19, 1938. The old scar was excised. A fairly large cyst with bluish walls was exposed. In the dissection, the cyst was opened inadvertently and more than an ounce of thin, dirty looking fluid escaped. It was found that the cyst went upward and outward to the styloid process, forward and upward to the submaxillary gland region and somewhat downward along the sheath of the great vessels. The cyst membrane was quite thin and appeared to have invasive tendencies, making its complete removal difficult. The wound was flushed out with ether and lightly packed with iodoform gauze. Recurrence was considered probable. However, the healing was slow, but satisfactory, and there has been no further evidence of recurrence after a period of three and one-half years. (Fig. 1.) Again, the pathologic examination was of no help in settling the question as to the nature and origin of the cyst. The impression at the time was that it was probably of branchiogenetic character, but in view of the record the exact diagnosis is still a matter of conjecture.

One case of pre-auricular branchiogenetic sinus, not included in this series, too, required a second operation before healing occurred. It would be gratifying to be able to include the report of a successful operation for branchiogenetic carcinoma, but again, unfortunately,

the pathologist was unable to determine the origin of a primary malignant tumor, removed from the submaxillary region, near the angle

amount of skin was made around the external opening and carried upward along the margin of the sternomastoid muscle. The duct was
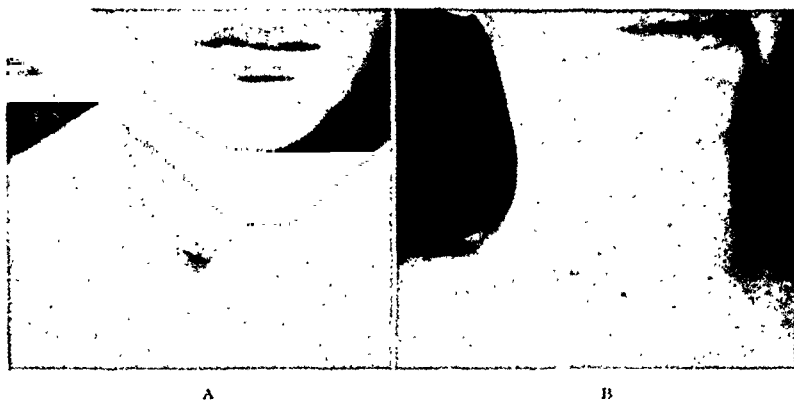
FIG. 2. Case II. A, congenital fistula of neck before operation; B, result after operation.

of the jaw and above the level of the hyoid bone. The patient was followed and remained well for nearly ten years, then was lost sight of.

The cysts and fistulas of pharyngothymic origin are apt to exhibit recurring attacks of infection and inflammation. Generally, there is an intermittent, sometimes a continuous discharge of secretion, from the external fistulous opening. Another symptom mentioned by some authors is an unexplained cough due to vagus nerve involvement. In order to cure such a fistula, usually associated with a cyst somewhere in the canal, it is necessary to excise the entire duct from the external opening up to the wall of the pharynx.

CASE II. Robert G., age seven, was admitted to the Post-Graduate Hospital in December, 1938. At birth, an opening not larger than a pinhead was noted in the right sternoclavicular region of the neck. On admission, it appeared as a reddened, raised, indurated, circumscribed lesion, with an opening in its center. A palpable, movable, cord-like structure could be felt along the border of the sternomastoid muscle. There was a history of repeated attacks of infection and intermittent, mucopurulent discharge from the fistula. Attempts to inject fluid through the fistulous canal were unsuccessful. Apparently, the anomaly was of the external incomplete variety. The operation was performed December 19, 1938. An incision including a small

easily freed until it passed under the posterior belly of the digastric muscle. By blunt dissection it was isolated up to the wall of the pharynx. A probe was introduced into the duct and its blunt end pushed through the posterior pillar of the fauces into the mouth. A short stump of the duct was then anchored in the eye of the probe and inverted into the mouth, after the method of von Hacker, and removed completely. Thus the whole of the thymus duct was dissected out. The wound healed promptly and the patient has remained well since the operation. (Fig. 2.) Pathologic diagnosis: pharyngothymic cyst and fistula, external incomplete type.

Dr. R. Franklin Carter has operated successfully upon a case of bilateral congenital fistulas of the neck. (Fig. 3.)

Comment. The stepladder method of Bailey gives a better cosmetic result and should be used, especially in females, in order to obtain inconspicuous neck scars. (Figs. 4 and 5.)

Thyroglossal Cysts and Fistulas. The embryology of the thyroid gland seems less complicated and the factors underlying the development of midline cysts and fistulas are better understood and less controversial than the branchiogenic and lateral cervical lesions. The midthyroid anlage maintains its upper connection with the foramen cecum through the thyroglossal tract, and the foramen cecum is the rem-

nant of the spot where the anlage developed. Toward the end of the second month this thyroglossal tract is separated into sinus, but *never* a complete fistula. In this respect it differs from the pharyngothymic ducts, from which fistulas complete and
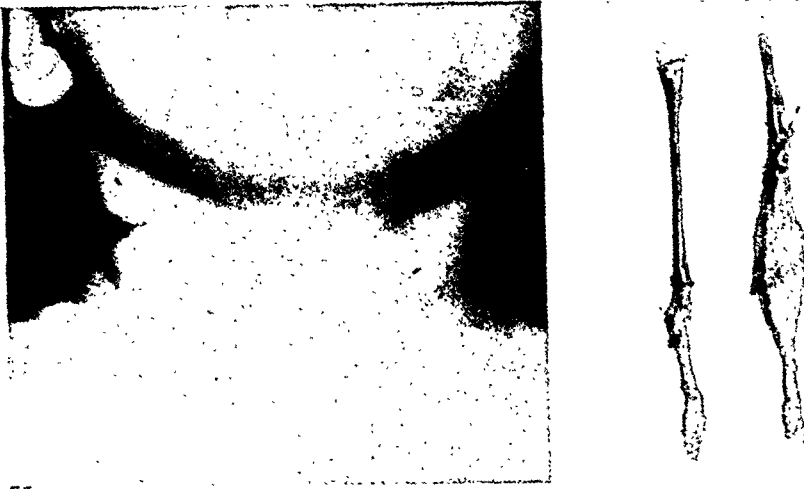
FIG. 3. Bilateral congenital fistulas of neck. (Dr. Carter's case.) Insert shows the ducts removed at operation.
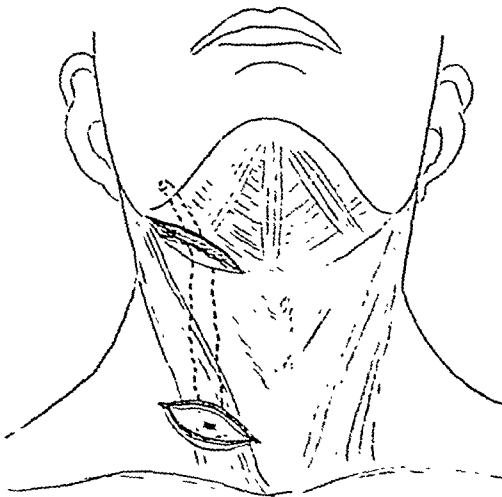
FIG. 4. Shows the parallel incisions in the Bailey step-ladder operation for congenital fistula of neck.
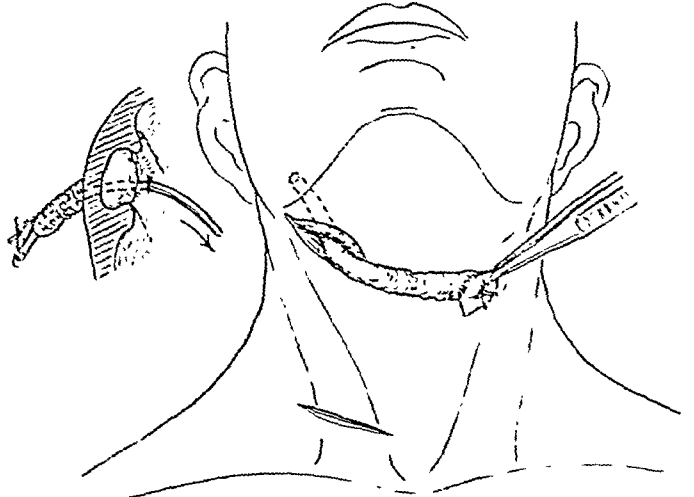
FIG. 5. Shows a continuation of the Bailey operation. The duct is dissected up to the wall of the pharynx and there cut off. Insert shows the von Hacker method of inverting the stump of the duct into the mouth.

upper and lower divisions by the developing hyoid bone. The lingual ducts are not a part of the thyroglossal tract, in fact, there is no thyrolingual duct or canal. The midline growths form along the thyroglossal tract, which *has no* lumen. There are two types: (1) Epithelial tubes or cysts, from which the ordinary midline cysts arise, and (2) the thyroid tissue rests, which may be the cause of abnormally located goiters. When a midline cyst, as a result of infection and suppuration, opens externally on the skin, it becomes a

incomplete, may arise. There is little difference between cysts and fistulas seen in the thyrohyoid region, for by obliteration of its opening, a fistula may become a cyst, and suppuration in a cyst may cause rupture and transform the cyst into a fistula.

A thyroglossal cyst which has discharged its contents spontaneously or by incision, has a corrugated lining, and may have minute channels or burrows extending into the surrounding tissues for some little distance. If overlooked and unrecognized

during attempts at radical excision, failure of the wound to heal completely and recurrence of the sinus are to be expected.

watery, glairy and mucoid, or purulent, but it is seldom profuse or continuous.

In 1920, Sistrunk published a method of

1. Usual course of thyroglossal duct and situation of cyst. At times, duct pierces hyoid bone. Possible sites of cysts are indicated - after Gilman
Foramen cecum
Duct
Hyoid bone
Cyst
Fistulous opening
Pyramidal lobe of thyroid gland

2. Incision

3. Fascia of sternohyoid muscles divided in midline and retracted - uncovering cyst. Dissection of cyst and duct carried up to hyoid bone
Hyoid bone
Hyothyroid ligament

4. Small central portion of hyoid bone resected

5. Index finger of left hand passed to base of tongue and by pressing downward and forward, shortening distance between foramen cecum and hyoid bone - Sistrunk

Muscles of tongue about tract cored-out to just short of foramen cecum

6. Core of muscle ligated and cut off. Often no muscle stitches or drain necessary

7. Skin suture

[Sistrunk Closure:- Core cut off and a few superf. muscle stitches; ends of hyoid bone sutured below split rubber drain]

Shepard

FIG. 6. Shows the steps in the removal of the whole thyroglossal tract in the operation for thyroglossal cyst or sinus. (Courtesy of Johnson and Johnson.)

The disfigurement of a thyroglossal cyst is not very noticeable, unless the tumor is large. The symptoms which usually cause a patient to consult a surgeon are recurring attacks of inflammation or a discharging sinus. Pain is not an important symptom, except during the periods of active infection. Discharge from the sinus, as a rule, is intermittent and slight, except when activated by infection. The character of the discharge varies: it may be clear and

complete removal of the whole epithelium-lined thyroglossal tract for the cure of midline cysts and sinuses. Before the adoption of his method results were uncertain and recurrences were frequent. After this radical procedure recovery is the rule and failure should be exceptional.

The technic of operation is as follows: A transverse incision is made over the cyst or a transverse elliptical incision is made around a sinus opening. Skin and platysma

muscles are reflected. The cyst or sinus is dissected free up to the hyoid bone; 1 cm. of the central part of this bone is resected, and then without any attempt to isolate the strand, the tissues surrounding it are cored out up to the foramen cecum. The direction from hyoid bone to foramen cecum, corresponds to a line drawn at angles of 45 degrees, backward and upward, through the intersection of lines drawn horizontal and perpendicular to the superior central portion of the hyoid bone. The cyst or sinus, a portion of the hyoid bone, a portion of the raphe joining the mylohyoid muscles and a portion of geniohyoglossus muscles are removed up to the base of the tongue. A forefinger pressing downward and forward against the foramen cecum shortens the distance and aids in the correct line of dissection. The geniohyoglossus muscles are brought together with a few sutures, the resected hyoid bone needs no attention, and the skin can be closed with clips. It is best to leave a small tube or tissue drain. (Fig. 6.)

Since the adoption of the Sistrunk operation, with only slight modifications, we have had on our service at the Post-Graduate Hospital, fifty-three cases of thyroglossal cysts and sinuses, operated upon by Dr. R. Franklin Carter and the author. The cases were scattered over a period of about twenty years. For fourteen years there were uniformly successful results. In 1934, an operation was performed upon a young girl, who had already had three previous operations for a thyroglossal cyst and sinus. The typical Sistrunk procedure was carried out, but the wound did not heal and a sinus persisted. The patient was taken to the Long Island College Hospital, and was operated upon successfully by Dr. Arthur Goetsch. A short time later another wound failed to heal, but we performed a secondary operation six weeks later, with a successful outcome. A little later, another patient, operated upon fourteen years previously, and well until two months before, developed an abscess and a thyroglossal sinus.

Here, too, a second operation was entirely successful.

CASE III. Lillian W., age six, was operated upon December 23, 1924, for a thyroglossal cyst, about the size of a hazel nut, noticed for two years. Radical removal of the cyst, a portion of the hyoid bone and the tract up to the foramen cecum was done. The patient remained well for over fourteen years.

May 1, 1939, the patient was again operated upon for a thyroglossal sinus, which had appeared two months before. The radical procedure of Sistrunk was repeated. The wound healed promptly, and the patient has remained well for three years.

Why did the first two cases fail to heal? It is probable that in both instances some small tract or burrow was overlooked. How about the recurrence after fourteen years? Some cell rest along the tract must have become activated, followed by the formation of a new cyst and later by infection, suppuration, and sinus formation. Meyer states that the "recurrence of fistulas may be due not to an incomplete operation, but may be a cropping-up of a further normal cyst, that had not enlarged, but which, secondarily, later became inflamed and then enlarged and broke through the old scar, the place of least resistance."

Cystic Hygroma of the Neck. Hygroma may occur in locations other than the neck—in the axilla, the groin, and retroperitoneally—but the neck is the most common site. It is a thin-walled, multilobar, multilocular, benign, neoplastic, cystic growth, lined with endothelium characteristic of lymph spaces, and arising from sequestrations of lymphatic tissue, derived from the primitive jugular sacs, which have failed to join the lymphatic system in the normal manner (Goetsch). There are, as a rule, no local or constitutional symptoms, unless the deformity or disfigurement of the growth be considered as such. Sometimes a hygroma may be rapid in its growth and cause pressure on important structures, such as the larynx,

trachea, nerve plexuses, etc. When it grows from the neck down into the chest cavity it may cause marked respiratory

Goetsch believes that palliative treatment, such as incision and drainage, and the injection of sclerosing solutions, are

FIG. 7. Case IV. Cystic hygroma of neck. A and B, before operation; C and D, four years after operation.

embarrassment. The larger growths are prone to become infected and such infection may result in grave constitutional symptoms, even death; rarely, it may be followed by a spontaneous cure. Infection gives such a high mortality that few surgeons can point to successful results, other than by radical surgical extirpation. Operation should be undertaken early, before the invasive and peculiarly destructive action of this growth, benign in its histology, but malignant in its potentialities, make complete excision impossible or the attempt inadvisable.

not only futile in effect, but they may cause dangerous complications. Even simple aspiration is far from being a safe diagnostic procedure. Irradiation, too, has given indifferent results, but is recommended as advisable in the large hygromatous growths in infancy, as a preliminary measure to complete surgical excision, which is requisite for a cure.

CASE IV. Thomas O., age four months, was admitted to Babies Wards of the Post-Graduate Hospital, April 4, 1938. A thin-walled cystic tumor, below and behind the left ear, was present at birth. It caused no symptoms, but

was growing slowly, and caused deformity and distortion of the external ear. At the time of admission it was 6 by 4 by 4 cm. in size. It transmitted light readily when examined. It was aspirated and found to be multilocular and to contain watery fluid. Aspiration was followed by some hemorrhage into the growth and later by active infection, which delayed surgical treatment for a time.

On April 8, 1938, an oblique incision was made below and parallel to the margin of the lower jaw and carried up behind the ear and over the mastoid region. A multilocular cystic mass, closely attached to the ear, and invading the parotid gland was dissected out. The operation was a delicate but not a difficult one. The wound was drained owing to the recent infection. Healing was slow, and more than once small collections of pus had to be evacuated from the wound. The final result appears satisfactory. (Fig. 7.)

Pathologic examination: Gross: The single specimen 4 by 3.5 by 2.5 cm., was a soft, friable, irregularly pyramidal mass. The outer surface was ragged with hemorrhagic connective and muscle tissue. On section, there was a network of gray connective tissue of varying density and thickness. The spaces between the meshwork were filled with clotted blood as well as with blood-stained clear watery fluid.

Microscopic: The basic structure recognized in several sections was that of a system of blood spaces. The endothelial lining of the blood spaces was not everywhere recognized, but the smooth muscle of the walls was easily seen.

Many of the blood spaces were greatly dilated and filled with whole blood. Others were obliterated by granulation tissue of varying maturity in which there were mononuclear cells containing brown pigment, probably hematogenous. This represented the organization of thrombi. In many places the connective tissue was firm, poorly cellular, dense, and markedly hyalinized. In such scarlike tissue, there were foci of lymphocytes. At the periphery of the specimen the striated muscle and areas of hemorrhage, probably operative. Here, too, there were areas of well preserved salivary gland, probably parotid. Pathologic diagnosis: cystic hygroma.

SUMMARY

The clinical classification of neck tumors shows the large number and the wide variety of these growths. The general remarks were intended to call attention to points of interest in connection with selected cervical lesions.

The subject of congenital cysts and fistulas has been given special consideration. The clinical aspects, principally, have been discussed, based on an experience with seventy-one of these cases, over a period of about two decades. Some of our problems have been related, in order to give emphasis to the well understood principle of complete surgical excision, which is the essential factor in bringing about a cure.

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KNOW YOUR PATIENT*

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HISTORY taking is important in that it gives you a chance to study your patient. As he unfolds the symptoms of his disease, it gives you some idea of his background. The age at which his grandparents and parents died, give you some idea of his structure, and structure is very important. The type you are dealing with gives you an insight into his outlook and reactions, but perfection in structure is another question. Two houses may look like duplicates, but the material employed may be very different.

Aging reaction is probably due to some secretory imbalance, slowly altering the internal constitution of the individual. In some people this change is almost imperceptible, while in others it is pronounced. Those changes are not characteristic of any one type, but are due to his structural inheritance. This theory is in keeping with our belief that structural deficiencies are Mendelian.

Surgical and medical treatment alone are not always sufficient or satisfactory unless you have some inkling of the psychology of the person you are dealing with; but if you can give the patient some information about his background and reaction, you will fix his confidence in you and make the subsequent surgical and medical treatment much easier. It pays to take time and patience so that you may gather all the information you can while apparently being interested only in the patient's history.

Within the last twenty-five years the laboratory has made the approach to diagnosis much simpler, but at what a price! It is like the navigator, instead of working out a problem with pencil and paper, he turns several wheels, looks at the back, and finds the answer to his question without understanding how he got there. It is much more interesting to spend a little more time studying your individual and using the laboratory only to check up on your diagnosis.

We measure the existence of everyone from birth to death. As a matter of fact, the most important period of existence is past when the person is born. The chances of maladjustment are numerous during fetal life. Deprived of water, oxygen, or food, for even a short time, may have very bad effects during intra-uterine and postnatal life. This is comparable to a noxia in postnatal life.

Nature is very exacting. Every organ and part of the body has the advantage of position at some period or other, and if it loses this, it never gets a second chance. In early fetal life the liver has the advantage of position until it has attained its full growth. As the abdominal cavity does not keep pace with the development of the liver and as two bodies cannot occupy the same space at the same time, most of the intestines remain outside of the abdomen until the liver has attained its full growth and then as the belly rapidly grows, the intestines slip into the abdominal cavity and finally the cecum and appendix cross the duodenum and rest over the right kidney, a position which is permanent in the dog. After birth the cecum gradually migrates into the iliac fossa, where it squats and as the result of a physiological peritonitis is permanently fixed in this position. Failure of this to occur results in a non-fusion of the mesentary, allowing 180 degrees rotation of the cecum. This is not

the only abnormality. Elbow deformity may aggravate this condition. Failure of the cecum and appendix to cross the duodenum and arrive in their proper positions, may result in non-fixation of the appendix on the left side.

Several recent studies have tended to indicate that human beings may be divided into groups or types according to their structural organization. Bean, who has studied racial types extensively in several parts of the world, has laid particular stress on the thin epithelial type and the robust connective tissue type. The first, or hyperontomorph, is a lank individual found to possess a long vertical stomach, short small intestine, and a long large intestine and small liver. The second, meso-ontomorph is fat and broad in general appearance with a large transverse stomach, a small intestine and a short large intestine. Each type, Bean believes, may be prone to a particular disease which occurs only rarely in the other type.

Stockard, studying from an entirely different standpoint, believes two chief types of individuals exist and that the one group differs from the other on account of having undergone its early postnatal development under a different complex of the internal secretions. The two types in the end correspond with Beans—the linear type being an individual that has had a high physiological thyroid bringing about early differentiation of organs and parts without excessive growth in size. The meso-ontomorph as a child had a low active thyroid, grew large in size, particularly in width, but its organ differentiation was slow. There are a number of correlated characters presented by individuals of characteristics shown by the other type.

Therefore a hyperontomorph or high thyroid type, would be mentally precocious and physically frail. He would have a vertical stomach; the small bowel would be subject during early childhood to alimentary disease. Certain ones of this type would have an acute costal angle, a long narrow chest, and a very active

nervous system. On the contrary, a low thyroid type, or meso-ontomorph, would be physically well developed, have a transverse stomach, the small bowel would be very long and the large bowel very short. He would have a good digestion and metabolism. Interpupillary distance is short in the linear type and long in the lateral type. Linear types are farsighted and lateral types, nearsighted. The arch of the mouth is high in linear types and short in the others. The linear type is always underweight for its size and between twenty and forty may not vary more than a few pounds, whereas the lateral type may be overweight and gain or lose fifteen or twenty pounds. The linear type has a large larynx and a baritone or bass voice, whereas the lateral type is usually tenor, having a small larynx. The linear type is full of ideas but is too nervous to work them out. The lateral type loves detail (and seldom has an original idea).

It is apparent that if a patient has a long narrow chest and an acute coastal angle, that the most suitable position for his stomach is vertical, and any surgical alteration will be unfortunate. It is, therefore, fundamentally incorrect to try to convert this congenital type into something altogether different. This applies with equal force to the position of the colon. Plication here would be just as ineffectual as in the matter of the stomach. In fact, fixation of organs that should be movable is a surgical error. On the other hand, the fixation of movable organs that belong fixed is surgically correct.

The alimentary canal is the one single system in the body. All others are bilaterally symmetrical. Are there compensations for the apparent deficiency, or does it mean that nature has felt this the oldest of all the systems to be so perfect as to be sufficient to the economy as a single unit? Has this interesting phenomenon any pathological significance? Does the length of the canal offer any explanation of its efficiency and what bearing, if any, has the fact that the diameter varies directly

with its length? Can any deductions be drawn from the fact that the pars pylorica is well developed long before there is evidence of any fundus? May not priority in origin point to priority in function? Has not the very fact of its amazing efficiency a bearing upon the well known law that as an organism approaches perfection it tends to self destruction?

In its extreme age, in its refinement of function, we may perhaps seek for some of the fundamental causes of its variations from the normal and for the resultant known generally as intestinal toxemia.

Like the many sects in medicine, each one of which sees truth through its own narrow slit, so also has the subject of intestinal toxemia. Some have considered it a mechanical condition pure and simple; some a neuromuscular one; some a disturbance of internal secretions; some as arising from a vasotonic disturbance; some a psychosis; some, like Adami, consider it a subinfection; some, like Combe, a hydrolytic process of bacterial origin. Non-partisan students are at a loss in seeking the truth from among this maze of authoritative statements.

One thing at least is clear, viz., that the causes are either exogeneous or endogeneous. The factors operating from without, like misplacements, displacements, obstructions, and bacteria which hydrolyze proteins within the lumen are totally separate and distinct from those of a biochemical nature which probably have their origin in the disturbed conditions in the cells of the intestinal epithelium itself and are probably endogeneous.

What part does the modern surgeon play in this complex problem? To our mind a very large and increasingly important one.

In 1916, I stated that the physiological surgeon would be the internist of the future. This view is not held without dissenting voice, for the general conception of the surgeon's place in the therapeusis of the canal, aside from the treatment of acute conditions, is that he may occasionally be of use to remove mechanical obstructions which cause constipation. Popularly this condition is known as stasis. We hold that this term is an unfortunate one because it implies mechanical rather than biochemical or physiological considerations, which seem to the essayists of far greater importance. This is not a plea against the mechanistic school which plays its important part, but fortunately surgery is no longer divorced from the sciences, having become an integral part of them. Thus its votaries will give great help in determining the etiology and therapeusis of the non-obstructive, non-static intoxications, in many of which surgical intervention alone avails. This means only that the diagnostician must now think in terms of both medicine and surgery.

The pathology of adolescence begins in utero. Until birth the child's future is predestined by the forces of nature. In childhood much can be done to correct congenital alimentary defects; at maturity, the individual to a great degree shapes his own career, quite aside from the limitations of his inheritance and environment. Thus there are three periods: the first, over which we have no control save through eugenics and this is uncertain, as mediocrity is always rampant; the second, over which an increasing control will be gained through increasing knowledge of child hygiene and therapeusis; the third over which control will be gained in direct proportion to the acquisition and diffusion of the truth regarding etiology, diagnosis, and therapeusis. Out of this vast field we have chosen to discuss in detail a few factors relating to the third.

Formerly, we looked upon the stomach as a receptacle which prepared food for digestion. Now we know that it has other important functions most essential to life.

The pyloric gastric glands secrete an intrinsic substance which, acting on an extrinsic substance in the food, produces a third factor known as erythrocyte maturing factor, which is necessary to the maturation of the red blood cells in the

bone marrow. Furthermore, the hydrochloric acid secreted by the fundus of the stomach, helps in the absorption of iron and probably has other functions besides.

It is a specialized morphological adaptation, useful but not essential. Similarly the cecocolon prepares the food for dejection. Who among us has not seen colectomized men and animals remain in perfect health, all diarrhea being controlled through the assumption of colonic function by its embryological prototype, the terminal ileum?

Even more significant is the fact that broken health has unquestionably been restored in human beings after partial or complete resection of the colon. It is far from our intent to argue that these organs have no function, for it is well known that along with all other groups of specialized cells, those of the stomach and colon must normally play an important part in balancing metabolism.

To complicate the problem of surgical diagnosis and therapeusis further, there are compensatory properties inherent in the alimentary canal just as truly as in the heart. A resected stomach may in part reform; an iliac segment transplanted into a colon will shortly assume both the size and in a measure the function of the colon, with the exception of anastalsis and ascending currents in mucous canals; a terminal ileum upon which, by the operation of ileostomy, the function of a colon is suddenly thrown will vicariously assume colonic function after a certain period, both as regards water absorption and fecal storage and dejection; an intestine will thicken oral to an obstruction and in proportion to the load, until, as in the heart, overload begets atony and dilation.

Thus it is more than ever clear that in the alimentary canal we are dealing with a system which, in part due to asymmetry, in part to extreme antiquity, and to the persistence in it of primordial zymotic reactions long dormant and now superseded by the nervous system, is endowed with many functions a few of the grosser of which are known, but most of which are utterly unknown. It is a system subject to the utmost variations of form due to both hereditary and to environmental conditions, and which save the brain, finally is the seat of the most complicated derangements of any part of our bodies.

Of the symptoms traceable to this canal one great surgeon has said, "We know so little as to their origin and treatment that we should consider ourselves the fools rather than the neurasthenic patients whom we seek to relieve."

Diagnosis of Adult Conditions. The diagnosis of adult intestinal toxemias has as its basis the cardinal symptoms of diarrhea and constipation. These conditions have been treated empirically from time out of mind, so that it is next to impossible to get either physician or patient to look upon them as symptoms rather than as entities. But progress demands it. As the modern physicist is showing that the supposed elements are really manifestations of a single basic ion and, therefore, not in a true sense elemental, so must we modern physicians realize that the ancient disease entities which we have been taught to believe in, are often not elements but are simply symptomatic, superficial and almost always protective manifestations. They are far more numerous than the sixty-odd old chemical elements, being the variable outward expressions of a fundamental disturbance of metabolic equilibrium and of nature's efforts to heal.

It is the old story of the objective method as opposed to the subjective, of function versus form, of biologic laws opposed to empiricism. It is significant that a true interpretation of symptoms has been the best means of improving therapeusis. We are, at best, only beginning to understand that most symptoms are protective and should be encouraged rather than suppressed until the true cause of the underlying disturbance has been found.

There is no field in all medicine more vivid with the truth of all this than that of the diarrheas. Let us urge that all diar-

rheas and constipations be looked upon as due to an exogenous cause until proved to be endogenous. Exogenous causes are either congenital or acquired. In our experience failure of fusion and departure from the normal migration of the cecocolon play a more important part than the acquired conditions, for they are transmitted by the same laws of heredity which govern transmission or other dominant characteristics. The common mesentery which results from non-fusion may permit of 180 degrees mesodorsad rotation upon adventitious bands which often support a cecocolon from the parieties constricting the ascending colon and causing a tadpole-like deformity with intermittent partial obstruction, as occurred in one of our cases recently. Such bands are doubtless manifestations of nature's efforts to compensate for the hereditary deficiency. No more potent argument is at hand in support of extensive undergraduate study of comparative anatomy and of research surgery on the lower vertebrates than this. For every graduate should know that from a common ancestor we may inherit departures from our conception of the normal; as for instance, a mobile duodenum or mesogastrium, such as are found in the dog, non-rotation, non-fused mesentery, an herbivorous type of cecum, infantile cecum, megacecum, absence of sigmoid (quadrupeds have no sigmoid according to Henscher and Bergstrand in Ziegler's Beitraege 56, 1913) or of cecum, and a host of other variants, explicable only by heredity.

The teaching of these fundamentals seems to us of far greater use than an ingrinding of the pharmacopoeia or of descriptive anatomy.

Bayliss and Starlings "Law of the Intestines" or myenteric reflex is of great importance in the surgical physiology of the alimentary canal. It consists in the production of a relaxation with inhibition of movements aboral to the spot at which a mass of food is collected and an increase of tone together with more powerful contractions oral to the spot, thus moving the contents onward.

We have for years contended that death from duodenal or jejunal obstruction is due to an interference with the internal secretory function of the epithelial cells of the gut itself rather than to bacteriotoxic causes. Now, if this is true of complete obstructions, what diversity of symptoms may not be caused by incomplete obstructions occurring at different levels! Doubtless the complexity of duodenal enzymes or hormones is much greater than that of any other part of the canal, though the subject is far from settled as to details; and this may explain the relative gradation of symptoms and the well known fact that their intensity varies as the square of the distance from the duodenum or thereabouts. Moreover, what has been accepted for the duodenum may be true also for the colon. This at least affords a working hypothesis to explain the immediate relief from certain of arthritides, as occurred in one case of our series after developmental reconstruction.

We are not sufficiently advanced in a knowledge of the internal secretions to say how important a disturbance of these may be in the colon, nor, indeed whether they exist; but if we are to believe Pick, even the lowly connective tissue cell of the colon secrets an enzyme called tryosinase. Furthermore, this matter of internal secretion of the gut may have an important bearing upon the phenomena which we have noted after ileostomy when there occurs a most marked change in the physical well being of the patient, as sudden and as profound as we have noted in the arthritides after colonic reconstruction. We have also noted nature's effort to compensate from any imbalance that may result from this operation by causing a marked dilatation and thickening of the cephelad illeum and the contraction and shrinkage of the excluded portion of the bowel to the size of a pencil.

Previously the clinical changes observed after this operation have been explained

wholly on the ground that the proteolytic anaerobic bacteria were unable to thrive on the acid media of the terminal ileum, and it is on this assumption that Metchnikoff popularized the value of the fermented milks. Here may be another point of similarity between the physiological mechanism at the beginning and end of digestion. The acid contents of the stomach are poured into the duodenum, so also are the acid contents of the ileum injected into the cecum. This mechanism works well in the absence of malignancy, but when malignancy occurs in either of those situations, some poisonous substance is evidently developed which is probably responsible for the primary anemia. A histotoxic anoxia may be the explanation.

It is accepted that a definite number of patients who suffer from the syndrome of intestinal toxemia, have been benefited or cured by operation, after other methods have been tried. What are the procedures which have been in general use? First, ileosigmoidostomy; second, cecosigmoidostomy; third, appendicostomy; fourth, ileostomy; fifth, plication of the cecocolon and repair of the cecal valve; sixth, total "colonic exclusion"; seventh, colectomy; eighth, developmental reconstruction or right ileocolectomy. The very multiplicity of procedures is in itself a certain index of our ignorance.

Ileosigmoidostomy has undoubtedly benefited a goodly number of cases. But what are its drawbacks? We have shown that a dominant anastalsis is often the physiological basis for the symptom constipation. All operations must be planned so as to minimize the effects of this symptom of aberrant physiology and if possible to counteract it. The foremost advocates of this operation admit that because of anastalsis in 10 per cent of cases a subsequent colectomy is a necessary corrective measure. Further, although we may learn to recognize sigmoidal anastalsis before operation, who can say that it may not develop as a result of this operation itself? The technic, therefore, has a much higher

mortality than is ascribed to it because of these secondary complications, and is rightly falling into disuse, except as a procedure prior to colectomy.

Cecosigmoidostomy is deficient both theoretically and in practice. Its employment leaves out of consideration the law to which we have referred, viz., that intestinal contests tend to follow the normal direction of the canal, irrespective of lateral stomas. Occasionally, nature performs its own anastomosis in order to insure continuity and overcome obstructions. We have seen this in several instances when operating for carcinoma of the sigmoid. Some loops of the small intestines became attached to the tumor, causing obstruction and the obstruction was relieved after nature succeeded in making a new opening that side-tracked the tumor.

Appendicostomy is safe though insufficient in most cases. One important fact in its favor is that it places the stoma oral to the entire colon. This is in keeping with our observations, viz., that a stoma to be effective must be oral to the infected area. This is very useful following the Lynch operation and in some cases of nonspecific ulcerative colitis.

Illeostomy. This procedure first intentionally employed in this country by us has limited and definite indications, but is of proved worth when indicated. It was devised and employed by an Italian some forty-five years ago.

Plication of cecocolon may benefit, but it is questionable whether the results are premanent, and this coincides with our animal experimental work. The technical defect may be that the co-aptation is peritoneal rather than muscular.

Colectomy has a place but it is a small one, because of the high mortality, but is indicated in diffuse polyposis, papillomatosis, diverticulitis, and in certain malignant tumors, and segmented infection of the colon.

Of the many operations which have been suggested, that of developmental recon-

struction has proved very satisfactory in certain carefully selected cases. The writer has applied this term to the ordinary operation of resection of the terminal ileum, the cecocolon, and the oral part of the transverse colon, because it exactly describes the procedure. The colon is reconstructed to the primitive or developmental type seen in the adult dog, or in the human fetus just following rotation, the great gut beginning in the right hypogastrium, there being no true cecum or ascending colon. We have believed that there may be a definite relationship between the symptomatic improvement in human beings after developmental reconstruction, and the fact that more primitive forms, like that of the dog, are free from colonic disease. We have called attention to the fact that this last formed portion of the colon is more liable to disease than the older aboral portion.

As in the case of other organs which have become diseased and dangerous to the economy, this organ, its function destroyed, should be removed.

One word in regard to colonic vaccines.

There is this to be said in favor of the vaccine treatment: That it usually helps; it is free from danger, and if an operation becomes necessary subsequently, it places the patient in the best possible condition to withstand it. It is valuable postoperatively.

Rectal feeding has long been a satisfying and comforting necromatic rite. It was ancient history when Hippocrates was a boy. Of all the delusions of grandeur ever inherited by the profession this was the most mythical.

At least, however, we have arrived at something definite, viz., the use of amino acids. Urinary studies prove this. These final products of protein digestion occur in the blood, dialyze readily, and are the logical postoperative sustaining agent of the future.

One cannot consider the field of colonic surgical therapeusis without being convinced that the future holds out great things, and perhaps the greatest of these is the hope that physiological surgery collaborating with medicine may help us to find the true cause and cure of many troubles which now seem obscured.

FRACTURES OF THE MANDIBLE*

REPORT OF FIFTY APPLICATIONS OF THE ROGER ANDERSON SKELETAL FIXATION APPLIANCE

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THE use of skeletal fixation in traumatic surgery is one which, in principle, has existed since the start

FIG. 1. Roger Anderson Appliance: A, B, C, Universal Frac-sure unit; A, pins; B, rod; C, clamp; D, fixation clamps; F, manipulatory connector; G, wrench; H, wrench for insertion of screws; horizontal part at bottom of illustration is the fixation rod; directly above fixation rod is a right angle wrench.

of the century. Its application in the past has been limited to use by the orthopedic surgeon. The development and embellishment since its conception has been considerable.

The use of pins or screws in bone surgery has, from its earliest application, been confronted with a "pin phobia" on the part of the profession.

With the advent of war and the ensuing injuries and problems of treatment, evacua-

tion, transportation and repair that ensues, there exists the need for a rapid and efficacious method in the reduction and im-

mobilization of fractures. This applies not only to those of the long bones but equally to that of the mandible, wherein if there is failure to introduce early reduction and immobilization, lifelong deformities will of necessity result. Further demands along these lines will include the treatment of shock and hemorrhage which are resultant from injuries to the facial tissues and underlying bony structures. It has long been recognized that the best treatment for

367

shock is its prevention; the earlier that treatment is instituted, the more rapid and more likely are the prospects for early and uneventful recovery. With this thought in

Doctor Roger Anderson, of Seattle, has further modified and developed the early principles of pin fixation with an apparatus to simplify the technic of reduction and
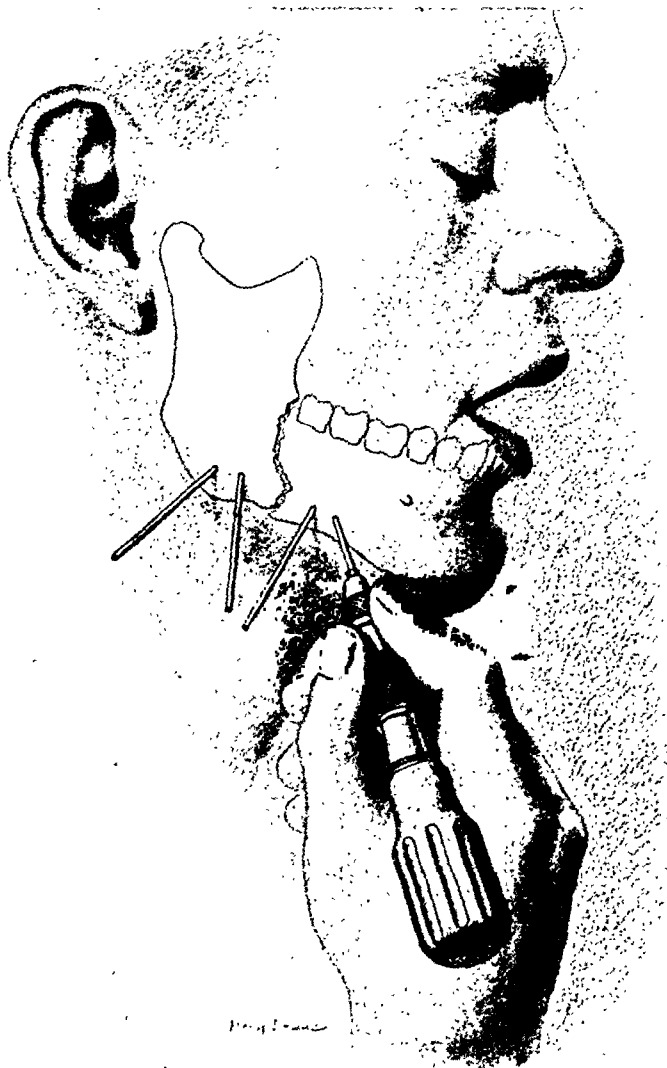
FIG. 2. Insertion of pins in Roger Anderson skeletal fixation for fracture of body of the mandible with elevation of the posterior fragment.

mind the fundamental concept to be considered in the treatment of mandibular injuries is to have an efficient method available which will satisfy the physiologic needs of the individual as well as the functional and esthetic demands. This calls for early reduction and immobilization with a minimum of complicated equipment that can be applied whether it be the dressing station, field hospital, evacuation hospital base, or on shipboard.

insure maintenance of immobilization. The appliance which Anderson employed in the treatment of fractures of the long bones has been modified and reduced to a smaller size so as to allow for its application in treatment of fractures of the mandible. (Fig. 1.)

ANATOMY

The treatment of fractures of the mandible cannot be fully understood without a
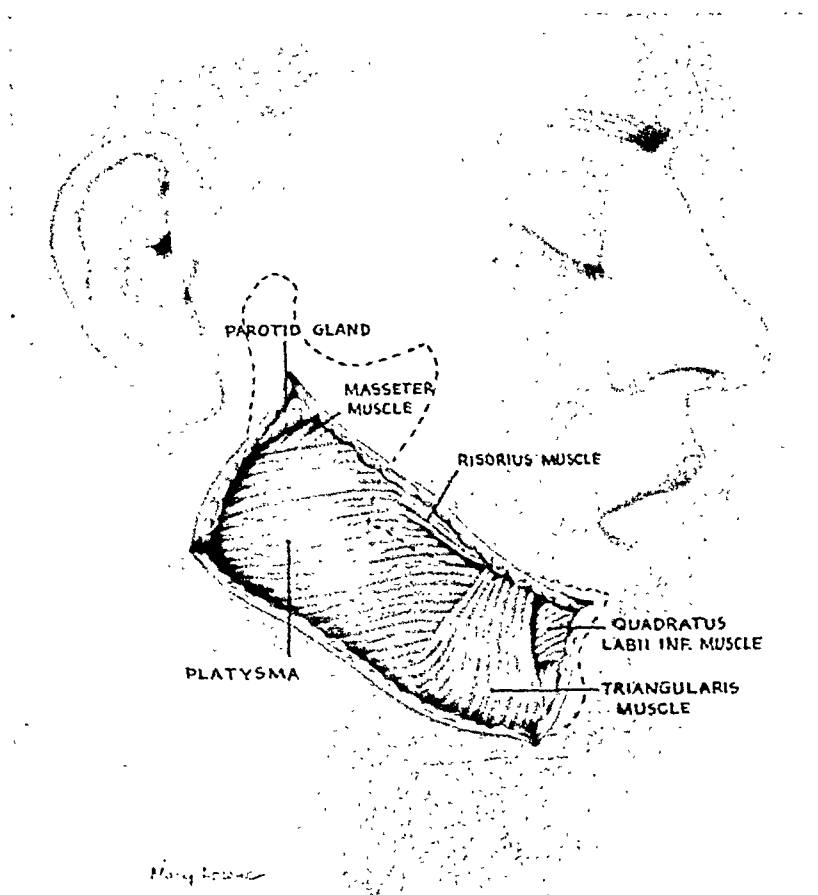
FIG. 3. Underlying musculature after removal of skin surface.
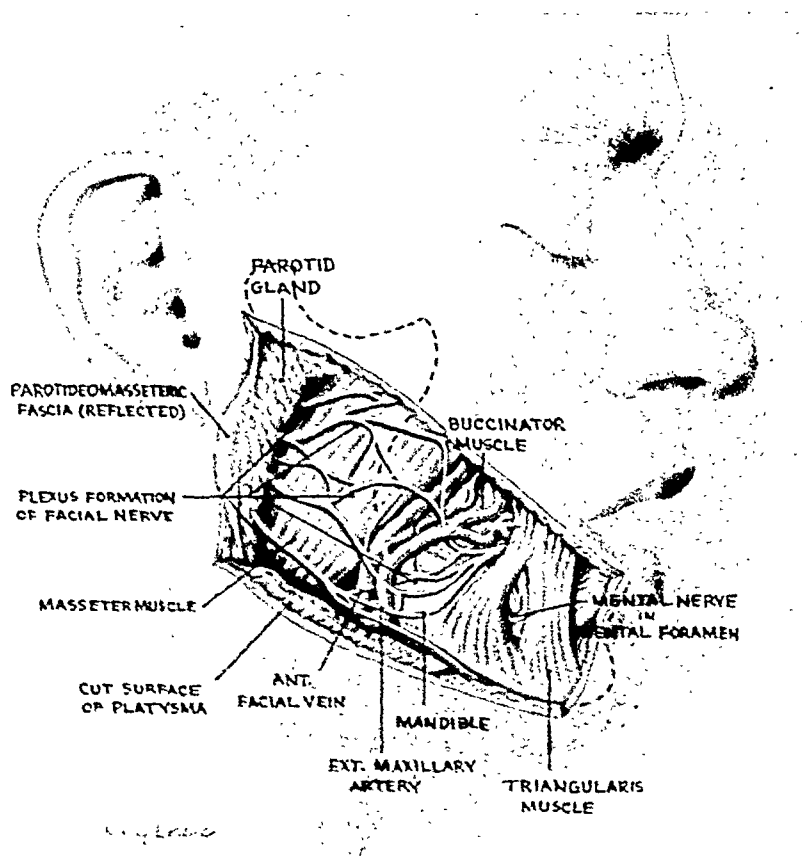
FIG. 4. Dissection following removal of the platysma and risorius muscles.

competent appreciation of the musculature involved, for it is on this basis the respective displacements take place. With the

FIG. 5. A, horizontal section through the mandible at the level of the insertion of the pins; B, Winter pin with circumscribed marking.

application of external appliances to the features of the face the underlying anatomical landmarks must be reviewed so as to realize the structures so associated.

The anatomical structures which must be avoided are (1) *The external maxillary artery:* This is avoided by palpating for the notch along the inferior border of the mandible and making the point of insertion for the pins at least one half inch away. (2) *Inferior alveolar canal and its containing structures:* By keeping the insertion of the pins approximately one-quarter inch above the inferior border of the mandible it will be sufficient distance away to avoid penetration of the canal. This decision is dependent upon the radiographic location of the canal. (Figs. 2 to 4.) (3) *Lingual nerve and artery:* These can be avoided by not inserting the pins beyond the cortex of the lingual surface to enter deeply into the tissues of the floor of the mouth and so engage these vessels. (4) *Mental foramen and its emerging structures:* The land marks of the mental foramen can be determined by a line passing through the supra-orbital notch and the infra-orbital notch. These, in conjunction with the mental foramen, are in the same vertical plane. The mental

foramen can also be located beneath and between the lower bicuspids.

Muscles	Origin	Insertion	Action
Elevators Masseter.....	Zygomatic	Angle and ramus of jaw	Muscle of mastication, molar teeth
Temporal....	Temporal fossa and fascia	Coronoid process of mandible	Elevator
Pterygoid (internal).	Pterygoid fossa of sphenoid	Inner surface of angle of the mandible	Elevates and draws mandible forward
Depressors Digastric Anterior belly	Inner surface of mandible	Hyoid bone	Elevates hyoid and tongue
Posterior belly.	Digastric groove of the mastoid	Hyoid bone	Elevates hyoid and tongue
Geniohyoid...	Inferior genial tubercle of mandible	Body of hyoid	Elevates and advances hyoid
Mylohyoid...	Mylohyoid ridge of mandible	Body of hyoid	Elevates and advances hyoid: forms floor of mouth
Platysma.....	Clavicle, acromion, and fascia	Mandible, angle of mouth, etc.	Wrinkles skin and depresses mouth
Rotator Pterygoid external.	External pterygoid plate of sphenoid 2. Great wing of the sphenoid	Neck of condyle	Draws mandible forward

A further review of the surgical anatomy would necessitate considering what structures are passed through in the application of the pins. Starting in the area at the angle of the mandible there are: (1) Skin, (2) fascia, (3) facial nerve fibers, (4) parotid gland, (5) platysma and masseter muscle, (6) mandible, and (7) internal pterygoid muscle toward the angle. Anteriorly there are the mylohyoid, geniohyoid and genioglossus muscles, all lingual to the mandible. (Fig. 5.)

ANESTHESIA

For anesthetization in this series of cases one of two methods have been employed. Those patients in whom there was considerable muscular displacement, general anesthesia by the endotracheal route was employed. This allowed for complete muscular relaxation to afford easy manipulation and reduction of the fractured parts.

The other method of choice was that of local anesthesia. This was administered

by one of two methods: extra-oral mandibular nerve block—the Labat technic—was employed in those instances in which there viously been cleansed, dried and fixed with tincture of iodine and alcohol. A Labat needle (3 inches long) was inserted at right
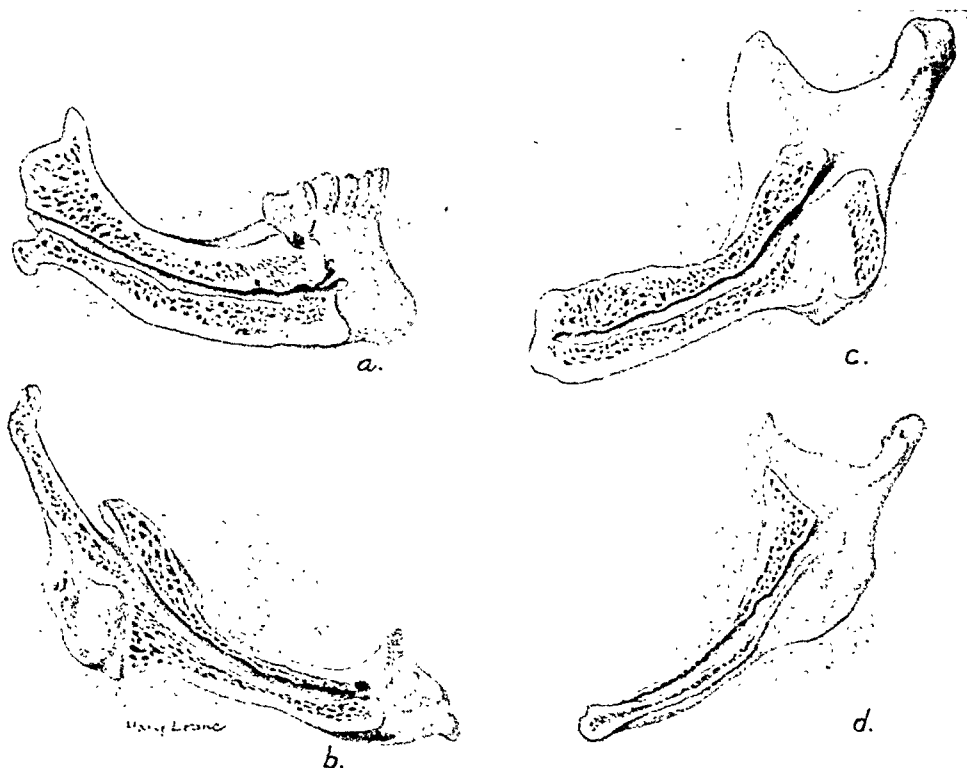
Fig. 6. Relation of the mandibular canal to the body of the mandible according to the degree of absorption of the alveolar process; a and b, lateral view; c and d, medial view.
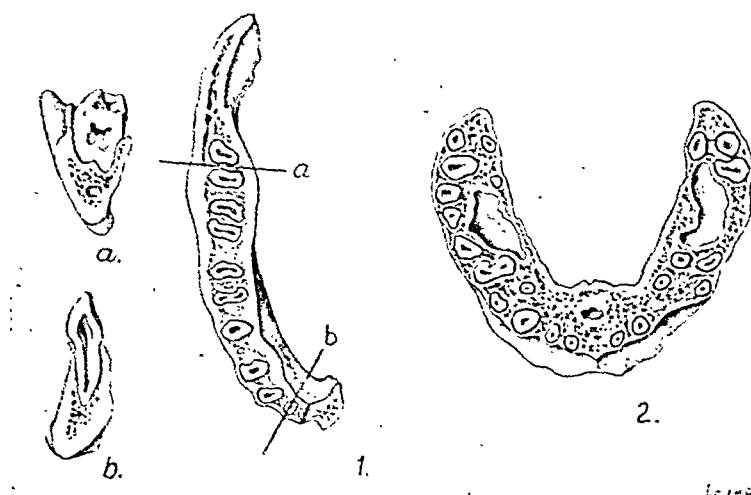
Fig. 7. Relation of the roots of the teeth to the body of the mandible. Lateral incisor (b) compared to last molar (a). No. 2 is the maxilla.

was edema or infection about the site of fracture, as follows:

With the patient's mouth open, the sigmoid notch was palpated and the index finger of the left hand placed at the inferior border of the notch. The area had pre-

angles above the index finger and directed inward until contact with the external pterygoid plate was made. The needle was withdrawn a few mm. and the direction changed to pass posteriorly and superiorly in the direction of the foramen ovale. At

the point of contact with the third division of the trigeminal nerve the patient will experience paresthesias of the terminal

FIG. 8. Marking the site of fracture and points for insertion of the pins is best accomplished with gentian violet. On colored individuals the markings are made with silver nitrate followed by sterilization of the skin surface with tincture of iodine which produces white markings.

endings of the nerve. The syringe was then attached to the needle and locked. When the aspiration test was negative 3 to 5 cc. of solution (novocaine 2 per cent, pontocaine 0.15 per cent, cobefrin 1:10,000) was injected.

The alternative method of local anesthesia was the block injection for the inferior alveolar nerve supplemented by an infiltration of the skin surface extra-orally and intra-oral infiltration for the buccinator nerve.

OPERATIVE TECHNIC

The area of the face, if male is thoroughly shaved and cleansed with tincture of green soap. The site and directions of the fracture are transposed to the external surface of the skin by indelible pencil or gentian violet markings. The inferior border of the mandible is palpated and just above it,

about one half inch on either side of the fracture line, marks are made for the points of insertion of the pins. (Fig. 8.) Care should be exercised to avoid the external maxillary artery, inferior alveolar canal and mental foramen.

The area of operation is painted with tincture of merthiolate. The body and face are draped, leaving exposed only the field of operation. With a Winter pin secured in a hand drill the skin is punctured with a straight jab until contact with the bone is reached. It is not advisable to turn the point through the tissue since the muscle and fascia would become entangled in the threads of the pin and make entrance and fixation in the bone difficult. With proper support to the fractured fragment a slow hand drilling process is performed. The pins are inserted at approximately 70 degrees to each other. This affords a greater contact with the cortical layers of the mandible and so insures firmer fixation of the pins. Once entrance into the bone is made, it is possible digitally to feel the grip that the pin is making in the bony substance. The rotation is continued until the $3/8$ inch marking on the pin has been reached and then, if further rotation is believed necessary it can be continued. This process is repeated with the second pin. Single pin clamps are then applied to each pin, at an equal distance from the skin surface, usually about $1/2$ inch. A rod is fastened through the respective openings in each clamp. In the middle of the rod a double clamp should be applied.

The bolts of each clamp are then tightened to insure that the unit is secure. This constitutes one Frac-sure unit. This procedure is duplicated with the third and fourth pins on the opposite side of the fracture and the second Frac-sure unit completed. With the occlusion of the teeth and the palpation of the inferior border as a guide, reduction of the displaced fracture is accomplished. While this is securely held in position the fixation rod is passed through the respective openings of the double clamps, the bolts of the clamps

Case	Type of Fracture	Location	Duration	Complications
W. S. (2)	Compound	Angle and mental foramen	4 weeks	None
W. F. (2)	Compound[1]	Angle and mental foramen	5 weeks	Abscess
L. M. (2)	Compound[2]	Angle and mental foramen	5 weeks	Osteomyelitis
T. D. (2)	Compound[2]	Angle and mental foramen	4 weeks	None
W. J (2)	Compound	Angle and mental foramen	5 weeks	None
G. M (2)	Compound	Angle and mental foramen	6 weeks	None
L. M. (2)	Compound	Angle and mental foramen	Still in position	
R. M. (2)	Compound	Angle and mental foramen	6 weeks	None
I. M (2)	Compound[4]	Angle and mental foramen	5 weeks	None
C. P. (2)	Compound	Angle and mental foramen	5 weeks	None
J. B (2)	Compound	Angle and mental foramen	5 weeks	None
F. K (2)	Compound[3]	Angle and third molar	5 weeks	None
W. R (2)	Compound	Angle and third molar	5 weeks	None
W. W (2)	Compound	Right and left third molar	4 weeks	None
F. M.	Compound	Angle	5 weeks	None
W. S.	Compound	Angle	4 weeks	None
H. M.	Compound[4]	Angle, zygoma, maxilla	Still in position	
O. S	Compound	Angle	4 weeks	None
O. H.	Compound[4]	Angle	Still in position	
M. Y.	Compound	Third molar	4 weeks	None
J. M	Compound	Third molar	4 weeks	None
W. P.	Compound	Third molar	4 weeks	None
G. M.	Compound	Second molar	5 weeks	None
H. B.	Compound	Second molar	5 weeks	None
R. B.	Compound	Second molar	4 weeks	None
S. E.	Compound[2]	First molar	5 weeks	Osteomyelitis
W. B.	Compound[4]	Mental foramen	6 weeks	Abscess
P. L.	Simple	Mental foramen	4 weeks	None
F. T.	Compound[2]	Mental foramen	4 weeks	None
W. B.	Compound	Mental foramen	4 weeks	None
F. S.	Compound	Mental foramen	4 weeks	None
W. J.	Compound[10]	Symphysis	6 weeks	Abscess
R. J.	Compound	Symphysis	4 weeks	None
B. S.	Compound	Symphysis	4 weeks	None
W. M.	Compound	Symphysis	5 weeks	None
O. L.	Compound	Symphysis	Still in position	

tightened and immobilization of the fracture attained. If, on radiographic examination, it is found the reduction has been incomplete, the bolts of each double clamp are loosened and further reduction attained. The bolts are then tightened. If the articulation of the teeth is found to be faulty, due to the extent of the displacement, it has been found efficacious to resort immediately to the use of arch wires, in conjunction with rubber traction to bring about the desired occlusion. This should be done immediately for it has been found that patients are apt to rebel against the intermaxillary fixation after once experiencing the freedom of motion. This extreme displacement which is found difficult to reduce is usually encountered in cases in which the fracture is of a week or more duration.

INFECTIONS

Throughout the entire series of cases no instance has been encountered in which an infection has been produced by the pins per se. In the application of skeletal fixation a phenomenon known as pin seepage occurs. It has been found that there is an

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[1] Abscess formation with no sequestration

[2] Osteomyelitis prior to insertion of pins. This necessitated their insertion at considerable distance from the site of fracture to insure no necrosis of the area and subsequent loosening of the pins.

[3] A combination circumferential wiring was performed for the fracture of the body of the mandible. The extreme displacement of the posterior fragment was taken care of by the application of Roger Anderson skeletal fixation. It would have been impossible to have reduced the right fracture completely by means of the circumferential wiring and for this reason the combination of the two was employed.

[4] Under treatment.

[5] The bilateral fracture in this case involved the refracture of a fracture ten months previous on the left side. The outcome of this case resulted in a fibrous union on the left side. It was impossible to say whether patient ever had complete bony union following previous fracture.

[6] Following the application of skeletal fixation this patient left the hospital at his own risk, and it has not been possible to get a report on his subsequent progress. (Fig. 9.)

[7] An osteomyelitis developed in this case but it did not start at the site of pin insertion. The necrosis that took place extended from the line of fracture through the second molar to encompass the anterior pins. This produced a loosening and necessitated their removal.

[8] This patient was admitted with a fracture of four weeks' duration with external incision for drainage.

[9] The threaded pin had been machined from a point 1/4 inch above the threads to the end to decrease its diameter. This metal has been replaced by fusing one of the acrylics to the pin producing an insulation. The purpose of this was to provide an insulation between the pin and the pin clamp. The observations in this case have been similar to others in regard to pin seepage.

[10] This case showed marked displacement and resulted in abscess formation which required external incision for drainage and extraction of tooth in line of fracture.

exudate of serous fluid from the point of penetration of the skin. This, in our observation, is the result of the constant these cases produced callous formation in from four to six weeks with the clearing of the infection.

FIG. 9. Case H. M. with horizontal fracture of the maxilla, depressed fracture of the zygoma and fracture through the angle of the mandible with elevation of the posterior fragment. The zygomatic fracture reduced; the maxilla fracture reduced and immobilized with tray and arms attached to plastic head cap; and Roger Anderson appliance used for reduction of the posterior fragment.

movement of the features and underlying musculature of the face with the resultant tissue exudate. This tissue exudate forms small crust formations and can be readily cleansed with cotton applicators. This has not been found to interfere with the process of healing and callous formation nor is it to be confused with an infectious process such as abscess formation. In our experience the two have not been found to be inter-related whatsoever.

The cases of infection that have been encountered have, in all instances, been in fractures of ten or more days' duration before presentation and fixation, and in which the abscess formation had already presented the characteristic clinical symptoms. The only precautionary measure that was employed in these cases was to insert the pins at a greater distance from the site of fracture than the usual ½ inch, so as to avoid the possibility of any necrosis extending into the area of pin fixation. All of

Removal of the appliance is a simple procedure and consists of a complete reversal of the technic of insertion. The double clamps are loosened and the fixation rod removed. (Figs. 10 to 19.) The procedure is repeated with the respective pin clamps and the removal of the rods of the Frac-sure unit. The pins are then removed with a counterclockwise rotation. The whole procedure is performed without anesthesia. The area is then cleansed with tincture of green soap, shaved if necessary, washed with alcohol, and collodion is applied to the pin openings to aid in clot formation.

REMARKS

The advantages of skeletal fixation seem to be many and the multiplicity of instances in which it can be employed urges the author to advocate its use. First, there are the problems of military warfare and second, there is the application of the

Roger Anderson appliance from the viewpoint of its applicability to the fracture itself.

hospitals. Success in the treatment of soft tissue injuries is not only dependent upon the skill of the plastic surgeon and the
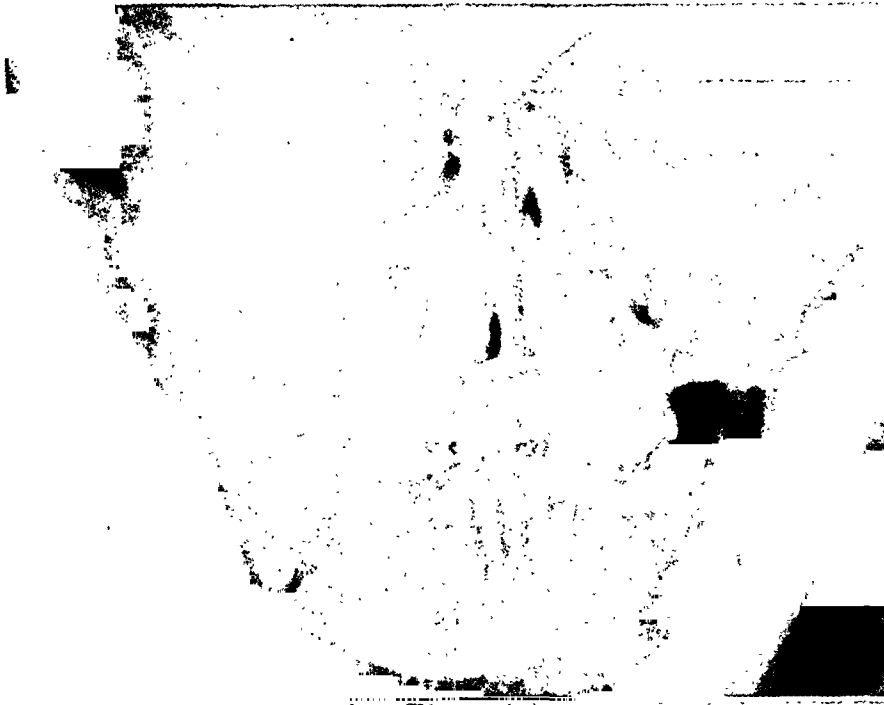
Fig. 10.

Fig. 11.

Fig. 10. Case J. M. Preoperative anteropostero plate.
Fig. 11. Case J. M. Postoperative anteropostero plate.

Wounds sustained in combat areas present the problem of emergency first aid measures subsequent to the transporation of the wounded to base or reconstruction "take of the graft," but it is also contingent on the situation which would allow the plastic surgeon to have an ideal area upon which to operate. Not only is radical

débridement a principle which should be avoided in the soft tissues of the face, but maintenance of space, the loss of which has

The ease and rapidity of application with a minimum of equipment can allow for immediate treatment of the fractures in

FIG. 12. Case J. M. Profile of patient with appliance attached.

FIG. 13. Case J. M. Photograph of patient with mouth open.

been produced by shrapnel injuries, must be considered. In this fashion bone grafts or the application of vitallium and tantalum plates can be subsequently performed, but these can have the maximum possibilities of success only when the space has been kept and no collapse of tissues allowed.

A second feature, characteristic of military surgery, is the necessity of rapid evacuation and transportation of the injured to sheltered areas in the rear lines or overseas. This necessitates some form of fixation of the fracture that will allow comfort and ease for the patient with a minimum of nursing care from an administrative viewpoint, and fixation of the fragments with adequate immobilization from the surgical viewpoint.

Skeletal fixation, as exemplified by the Roger Anderson appliance presents a device with a simplicity of application that will fulfill the demands of military warfare.

any field hospital or first aid station. The absence of intermaxillary fixation avoids the complication of nausea and nursing problems during the transporation of the patient. The feeding problem does not exist with this form of fixation and here again there is minimization of the nursing problem. However, in the problem of space retainer, from the surgical viewpoint, the application of the Roger Anderson skeletal fixation appliance has its greatest value. This, combined with the ease of manipulation, makes it highly indicative from the discussed combat aspect.

In a consideration of civilian traumatic injuries, the problems of transportation, and nausea are not as prevalent. From the viewpoint of the type of fracture for which skeletal fixation is indicated, there is the problem of reduction of the posterior fragment. In reviewing the other methods that have been successfully employed there is the plaster head cap with wire traction

FIG. 14.

FIG. 15.

FIG. 14. Case J. M. Lateral plate revealing elevation of
posterior fragment.

FIG. 15. Case J. M. Postoperative lateral plate showing
reduction of fracture with Roger Anderson appliance.
Because of the proximity of the inferior alveolar canal
to the inferior border, the anterior pins were applied
above the canal.
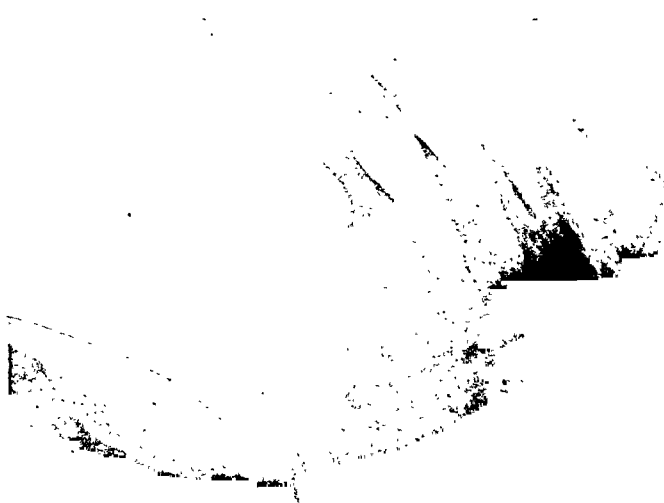
FIG. 16. Case J. M. Lateral x-ray plate showing bony
union with perfect apposition of posterior and anterior
fragments.

for the reduction of the posterior fragment, open reduction with vitallium plate, or interosseous wiring. All these methods

FIG. 17. Case J. M. Photograph showing occlusion of teeth.

necessitate open operations with the exposure of the angle of the mandible and are extensive operative measures in comparison with skeletal fixation. In regard to

displacement produces a comminution of the fragments as a result of the powerful tendency and pull of the mylohyoids are found to be best treated with the application of an arch wire in conjunction with a Roger Anderson appliance. In this fashion the patient can still retain adequate motion and function of the mandible and yet maintain complete immobilization.

With respect to the teeth in line of fracture, the use of skeletal fixation presents a distinct advantage over other methods of fixation. To begin with, the necessity of retaining any particular tooth as a means of securing an arch no longer exists. The necessity of retaining a third molar in line of fracture in order to occlude with the upper teeth to depress the posterior fragment similarly affords no problem in the use of skeletal fixation. In an effort to avoid abscess formation, any questionable tooth may readily be removed at the outset of the case or at any

FIG. 18. Case J. M. Profile view one week following removal of appliance.

FIG. 19. Case J. M. Front view of completed case.

fractures of the edentulous mandible, in which there is much displacement of the fragments or in which the fracture is beyond the molars, the efficiency of circumferential wiring is considerably curtailed and does not compare in efficacy with that of the Roger Anderson appliance.

Fractures of the symphysis in which the

time during the length of treatment since complete access is always available into the mouth.

Depressed fractures of the maxilla, of either the horizontal or vertical type, afford a further problem when complicated with fracture of the mandible. The immobilization cannot consist of intermaxil-

lary fixation, since the maxilla is no longer a fixed point. Any movement or attempted opening of the mouth would only further displace the maxillary fracture. These patients are best treated individually. For the fracture of the mandible, the ideal method would be skeletal fixation since this would in no manner interfere with whatever prescribed treatment is applied to the maxillary problem.

A distinct contraindication for the application of Roger Anderson skeletal fixation is in the treatment of fractures of the mandible in children. Because of the presence of tooth buds beneath the deciduous teeth, the insertion of pins could produce a distinct injury to the permanent teeth.

CONCLUSIONS

The advantages and indications for application of the Roger Anderson skeletal fixation are: (1) Ease of application; (2) maintenance of immobilization and further reduction when needed; (3) complete function of the mandible; (4) minimum of nursing; (5) no feeding problem; (6) simple technic for reduction of posterior fragment; (7) no concern in regard to nausea and vomiting; (8) In macerating injuries of the face in which, segments of the bone have been lost, the appliance is applicable for the maintenance of space. (9) Extraction of teeth whenever removal of teeth is indicated in view of the loss of investing bone substance which would result in possible non-union or abscess formation. With

intra-oral fixation such teeth would have to be retained to serve the purpose of holding the posterior fragment down or as an anchorage for intermaxillary fixation. (10) Ability to treat fractured mandibles when there is the added complication of a fractured maxilla.

In the selection of an appliance for the treatment of fractures of the mandible, definite evaluations must be made: First, Insofar as the reduction of the posterior fragment is concerned, skeletal fixation should be used in preference to any open method of reduction. Second, in edentulous mouths, in which circumferential wiring cannot be employed, i.e., no intra-oral appliance can reach the posterior portion, skeletal fixation would be the method of choice. Third, in fractures of the body of the mandible, in which intra-oral fixation could be successfully employed, it is a matter of personal equation as to whether the patient desires to use his jaws during the process of healing or whether, because of aesthetic appearance, he would prefer immobilization and fixation of the jaws, and subsist on a liquid diet.

When skeletal fixation, by means of the Roger Anderson appliance fails to restore the original occlusion or articularion, intermaxillary force should be applied immediately to reduce the musculature displacement. This may have to be kept in position for three or four days. Failure to do this at the time, permitting freedom of the jaws for even a few days, will find the patient unco-operative.

INGUINOFEMORAL ANATOMY*

ASPECTS SIGNIFICANT FOR INGUINAL HERNIORRHAPHY

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THE phenomenon of inguinal hernia exhibits a wide diversity of form. It is signalized in surgical literature by the recording of a corresponding multiplicity of plastic therapeutic procedures. Inguinal herniorrhaphy appears almost as a prototype of surgery's attempt to minimize and eliminate the vulnerability of man's material structure. It seems to be literally a microcosm of surgery in which the anatomy of the operative region seems particularly intriguing and is at once both seductive and exasperating, ever tempting and teasing the ingenuity of the operator.

In the main, most of the modifications and variants of the original Bassini and Halsted operations excogitated either under the stress of the actual surgical moment or in the composure of dissecting room study have been of solid value for any given hernia problem. Collectively, they provide the eclectic surgeon with a choice of procedures supplying the technical solution of the very great majority of reparative dilemmas. Zimmerman[1] in his review of the recent trends in the treatment of inguinal hernia writes that the "Growing emphasis upon the anatomical lesion present in the various types of hernia and an attempt to match the surgical procedure to the specific lesion point the way to better results in the surgery of inguinal hernia."

Certain details of inguinofemoral anatomy are submitted here with a view toward refreshing anatomic insight of the region and an attempt made to construe some practical utility therefrom. Though no illustrative case file is available at this time to accompany the data, these seem arresting enough to merit presentation. The convenience of presenting them within a surgical frame of reference will be evident. Accordingly some few gleanings from the later literature pertinent to an analysis of the findings described here will be given.

Tanner's[2] modification of the Bassini operation may be cited first because it appears to illustrate a device of tissue maneuver applicable to these findings and also because it easily orients the discussion in its allusion to technical points still moot in the general problem of herniorrhaphy. According to Tanner, his method is a "sliding of the sheath of the rectus muscle downwards and laterally in such a way that a repair of the posterior wall of the inguinal canal with living and functioning muscle is attained . . . a curved incision is made, through the fused aponeurosis of the internal oblique and transversus, commencing at or slightly below the level of the pubic crest and as far medially as the dissection will allow. This incision passes straight upwards, then curves outwards to end a hand's breadth above the pubis and about two cm. medial to the lateral edge of the rectus abdominis muscle . . . As soon as this incision is made, there is a tendency for the lateral edge of the incision to slide downwards and laterally . . . It will now be observed that the high arching fibres of the internal oblique (conjoint tendon) are flaccid and straight and tend to lie parallel to Poupart's ligament. Even if the lower fibres of the internal oblique were deficient some

muscle fibres will now be found close to Poupart's ligament. Interrupted silk sutures are now placed so as to unite this

of three arches traversed by the spermatic cord: "The contraction of the external oblique approximates the anterior wall to

Fig. 1. a, external oblique aponeurosis; b, Poupart's ligament; c, fascia lata; d, upper crescentic margin of fossa ovalis; e, sheathed femoral vessels.

tissue to the reflected part of Poupart's ligament . . . A fine continuous silk suture is now run between the lateral cut edge in the rectus sheath and the adjacent rectus and pyramidalis muscle . . . "

It is seen that in Tanner's method the subcutaneous mixed elements of the body wall are deployed in a way which exacts the maximum efficiency physiologically characteristic of each element within the conditions of the plastic re-arrangement. This stands as a favorable concrete commentary on the debatable point of suturing fascial tissue to muscle. Both the rectus muscle, uncovered and sutured to its own fascial sheath, as well as the dislodged muscular portions of the falx have had their effective contractile function preserved to a great degree. Avoidance of compromise of this intrinsic dynamic faculty of the body wall structure herein involved has always loomed large in the consideration of every surgeon. Grant[3] interestingly re-states this mechanism when he describes the inguinal canal as an "inguinal arcade," likening it to an arcade

the posterior wall and the contraction of the arched fleshy fibres of (the inguinal portion of) the internal oblique and transversus causes them to become straighter and taut, in consequence of which the roof of the canal or arcade is lowered and the passage constricted. The action is that of a demi sphincter."

Tanner's slide operation encumbers this mechanism to a minimal degree. Neuhof,[4] and earlier, Anson and McVay[5] have introduced the use of Cooper's ligament as a substitute for the Poupart anchorage because they question the latter's adequacy and suitability. Neuhof states that "whether the conjoined tendon or rectus sheath or aponeurosis of the external oblique are joined to the reflected surface of Poupart's ligament, . . . the objective remains a protective shelf and not a direct support of the undefended space and that the utilization of Cooper's ligament instead offers direct support to the mesial portion of the undefended space in the form of a sling like buttress, and also reduces to some degree the size of that space." Anson

and McVay criticize the use of Poupart's because it "is not the insertion of the transversalis fascia, the transversus ab-

in the upright or hernia producing attitude, the space is seen to have the appearance of an inverted gable or trough with the

Fig. 2. a, superomedial leaf of external oblique aponeurosis; b, edge of conjoined tendon; c, transversalis fascia; d, inferolateral leaf of external oblique aponeurosis; e, Poupart's ligament; f, spermatic cord.

dominis aponeurosis, or the internal oblique aponeurosis; its relationship to these structures is simply one of contiguity. From an anatomical standpoint this is reason enough for endeavoring to find some other structure for anchorage." In contrast to the innovation rationalized by these authors Tanner implicitly reaffirms the architectural convenience and structural reliability of the inguinal ligament so invariably assumed by the earlier writers.

Reflection on the characteristic configuration of the body walls in the inguinal region may be helpful at this point. The general celomic space is made up of three distinct portions: that of the true abdomen, that of the false or greater pelvis and that of the lesser or true pelvis. That portion, the conformation of which is significant in the consideration of hernia is that of the greater pelvis—that area enclosed by the iliac fossa and the lowermost portions of the musculature of the anterior body wall. Observing the body

sides unequally and irregularly warped and slantingly placed. Because the anterior superior spine and the pubic tubercle occupy virtually the same frontal plane, the lowermost portion of the anterior body wall, terminating in the inguinal ligament, forms the relatively flat anterior wall of the trough. This anterior wall, endowed with the physiological action alluded to in Grant's description, effects its retaining function dynamically. The surface bounded above by the iliac fossa traverses a warped spheroid plane and constitutes the posterior wall. The crest of the inverted gable or rather the angle of the trough is formed by the junction of the inguinal ligament and its lacunar reflection with the structures lining the false pelvis, namely, the iliopsoas muscle, and the sheathed femoral vessels. The notion of an inguinal trough is incomplete unless it comprehends two other elements —the iliopsoas fascia and the fascia lata. This is true because although the inguinal ligament ostensibly constitutes the essen-

tial feature of the angle of the trough, both the fascia lata and the iliopsoas fascia contribute substantially to the stability

that the liberation of the fascial structures in the thigh had reduced the taut fixity of Poupart's ligament and, while leaving

FIG. 3. a, superomedial leaf of external oblique aponeurosis; b, edge of conjoined tendon; c, spermatic cord; d, Poupart's ligament; e, fascia lata; f, edges of incised fascia lata.

of its architecture, making their continuity with the external oblique aponeurosis, i.e., its caudal limit, the inguinal ligament, functional as well as positional. This functional continuity seems implicit in Gray's[6] description of the attachments of the inguinal ligament: "the superficial portion of the fascia lata . . . is attached . . . to the whole length of the inguinal ligament and to the pectineal line in conjunction with the lacunar ligament," and "the iliopsoas fascia lateral to the femoral vessels is intimately connected to the posterior margin of the inguinal ligament."

The brief anatomical investigation submitted here is offered in support of this implication. It was prompted in order to clarify and establish anatomical validity for surgical exploitation of a phenomenon observed by the writer in the course of a Wangensteen repair of a recurrent hernia. At that time it was noted that coincidentally with the loosening and mobilization of the fascial flap in the thigh the inguinal ligaments relaxed and moved up along the abdominal wall. It was apparent

its orientation to the other musculo-aponeurotic structures intact, had permitted it to shift—almost in toto—closer to these structures. This movement as might readily be understood, very appreciably narrowed the gap, the covering of which, is the basic desideratum of approximating the parts of the "inguinal arcade" in any dynamic or static succession or combination whatsoever, to Poupart's ligament. What had been observed was an uncalculated process analagous to Tanner's slide maneuver but with the slide initiated from below and mediated through the manipulation of other tissues.

The subsequent anatomical studies consisted in full visualization of the phenomenon on ten dissected inguinofemoral areas, four on embalmed and six on fresh unembalmed material. It was found that in each instance a horizontal incision of the thigh fascia—specifically the fascia lata—beginning at the midpoint on the periphery of the crescentic falciform margin of the fossa ovalis and extending outward across the thigh effected a loosening and relaxation

of the inguinal ligament similar to that observed at the operating table and allowed the same upward movement of the ligament ahead of the gliding fascia. Complete cleavage of the fascia lata from the subjacent iliopsoas fascia was readily accomplished, increasing this relaxation, and better still, stripping the iliopsoas fascia from the underlying muscle made the relaxation virtually complete. The upward advance of the ligament now reduced the space between it and the musculotendonous arch above it (internal oblique, conjoined tendon, lowermost portion of the rectus sheath) to a mere crevice.

It had appeared plausible to the writer then, that possibly the purposive device of freeing the fascia in the upper anterior thigh might be extremely useful in the routine repair of ordinary hernia. It would, as stated before, reduce the gap to be bridged in the closure of the defective anterior inguinal wall, thus lessening the tension on the structures used in accomplishing this bridgement, and, would seem to give most effective promise of precluding recurrence. The inguinal ligament having relinquished its position at the angle of the inguinal trough would have become a more accessible ledge to which Grant's inguinal arcade could be moored and its topographical site occupied by the thigh fascia after its glide upward to a higher position on the thigh. The fascia would now be a component of the inguinal trough. Competence of the trough should result since the same adaptibility for security of union exhibited by musculofascial suture in the upper inguinal phase of the usual herniorrhaphy could be relied upon to give solidity to the infraligamentary closure of the trough by suture of the fascial strata to the thigh muscles. But even more important than the effectiveness of musculofascial suture, and, perhaps crucial, would be the tensile power of the thigh fascia itself. This is especially true in the face of Anson and McVay's adverse estimate of the stability of union between the inguinal ligament and the fascia lata.

In the dissections described here this stability seemed energetic enough since it was found that with the fingers placed behind the stripped up fascia, sustained advancing ventral pressure forced them not through the fascia or the oblique aponeurosis or through the line of fascial-aponeurotic continuity, but rather guided them up behind the inguinal ligament and into the pelvis where simultaneous visualization of the dissected body cavity disclosed the exploring digits to be entirely retroperitoneal and in direct contact with the intracelomic portion of the iliopsoas fascia. Anson and McVay write that "the inguinal ligament itself is a marginal structure separate from the fascia lata of the thigh" and that "the inguinal ligament, contrary to the usual conception, is loosely held in its convex position by the surrounding fasciae; it is easily shelled out of its fascial bed by the finger or a blunt instrument, to become merely the free margin of the aponeurosis which extends between the anterior superior iliac spine and the pubic tubercle. Its attachment is broadened laterally by fibres of insertion passing into the iliopsoas fascia and medially by the expansion known as the lacunar ligament; between these two points it is relatively pliant. When traction is applied in a cephalad direction, simulating the pull of the muscles which might be sutured to it, it is displaced superiorly far enough to leave the lower inguinal region completely exposed beneath it. In recurrent hernia occasionally the mass seems femoral in position, hernia having elevated the inguinal ligament."

These statements give the present interpretation of inguinofemoral fascial aponeurotic elements a controversial profile and seemingly dislimn the picture of a design of practical usage envisioned for them as projected herein. Yet neither do they discount the fact of the inguinal ligament's potential mobility and in this respect it may be that the significance of the fascia as here contemplated with regard to its management in herniorrhaphy is gratui-

tous. Pack and Reker's[7] description of their surgical groin dissections for malignant tissue tumors of the region is pertinent here since it may lend some support to the *a priori* validity of the maneuveribility of the inguinal ligament. They write: "The dissection proceeds from above downward, removing all the fascia from the muscles of the anterior thigh (sartorius, iliacus, pectineus, adductor brevis, rectus femoris)." A step is then taken "giving exposure of the inguinal canal which is incised from the external ring to the point where the round ligament or spermatic cord dips downward into the pelvic cavity. The canal is further exposed laterally by incising the external oblique fascia and the transversalis muscles down to the properitoneal fat . . . The external oblique fascia and the inguinal ligament are then severed about two inches from the attachment to the pubic spine . . . The entire groin dissection is performed with the scalpel and at the completion of the operation practically no fat or fascia should be left in the operative field except the normal structures necessary to reconstruct the inguinal ligament and canal. . . . The inguinal canal is then closed in the manner customary for herniorrhaphy. The inguinal ligament is reconstructed and sutured around the femoral vessels without occluding them." In this procedure it is seen that the inguinal ligament is dislodged and is completely without benefit of the thigh fascia. Yet the reconstruction of the inguinal trough has been effected. Presumably, the movement of the inguinal ligament as described herein and shown in Figure 3 has occurred. It appears evident that if the inguinal trough deprived of all fascial elements is competent, then a fortiori following the tissue maneuver here pictured, that same degree of competence and serviceability should remain.

It would seem then, that freeing the fascia in the upper anterior thigh as here described, might be extremely desirable and useful in the routine repair of ordinary inguinal hernia, and what is most important very considerably preclude recurrence. Regardless of whether the primacy of a dynamic or static function of the available structures of the abdominal wall is to be invoked in a given repair the execution of such a maneuver could be integrated with those features characterizing established procedures and confer on them a greater efficacy. Robins's[8] union of lower rectus sheath and muscle to the ligamentous tissue on the superior surface of the pubic bone; Jones'[9] distinctive use of the combined transversalis fascia and transversus aponeurosis by conducting it through the internal oblique muscle on its way to attachment to Poupart's; Zieman's[10] less elaborate and adynamic employment of the transversalis fascia; Stein's[11] avoidance of direct muscle suture by developing and mobilizing the internal oblique fascia; each of these mutations and evolutions of the Bassini and Halsted operations would all be used with greater advantage.

The following remarks are offered as an aid in distinguishing and identifying the labeled parts of the photographic figures:

Figure 1 shows the deep surface of the inguino femoral terrain. The skin and superficial adipose tissues and fasciae (marginal elements derived from Colles and Scarpa's layers) have been mostly removed. The apparent and obvious continuity of the external oblique aponeurosis and fascia lata is plainly seen, the linear oblique ridge indicating the site where, with regard to the functional purpose contemplated for these elements, the unitary character of the two structures would be of crucial importance. The upper falciform margin of the fascia lata where it forms the superior crus of the fossa ovalis is easily discerned; the cribriform fascia has been removed and the femoral sheath or envelope enclosing the femoral artery and vein are also indicated.

Figure 2 displays the inguinal half of the field. The aponeurosis of the external oblique has been incised. The resulting

infernolateral leaf has been turned down. A superomedial leaf has been developed and turned up. The spermatic cord severed from its scrotal half is turned aside laterally across the infernolateral aponeurotic leaf. The inguinal canal is accordingly uncovered with the conjoined tendon and lowermost portion of the sheathed rectus, Poupart's ligament, and the "pavement" transversalis fascia readily distinguishable, too. The gap between the arched margin of the musculotendonous-fascial elements of the "inguinal arcade" and the inguinal ligament is evident with the structures as here viewed in their normal position.

In Figure 3 the view is widened to envision again the composite inguino-femoral region. The hemostat grasping Poupart's has easily drawn it up to the edge of the "inguinal arcade," because the thigh fascia has been incised beginning at the periphery of the crescentic falciform margin of the fossa ovalis at a point marking the inferolateral extremity of an oblique axis or diameter of the fossa and from there extending outward across the thigh.

SUMMARY

Aspects of inguinofemoral anatomy are briefly reviewed.

Relevant anatomical studies are described and attention called to details of fascial-aponeurotic function in that region.

Their surgical application in the technic of inguinal herniorrhaphy is suggested.

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OVARIAN CYSTS COMPLICATING PREGNANCY

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PREGNANCY when complicated by the presence of an ovarian tumor may follow an entirely uneventful course, but on the other hand serious conditions may arise that endanger the pregnancy and threaten the life of the patient.

The presence of an ovarian cyst constitutes one of the most menacing complications of pregnancy. Usual accidents- to ovarian cysts in the non-pregnant are more apt to occur in pregnancy. Some- of the following serious possibilities are to be mentioned. Abortion or premature labor may occur; torsion of the ovarian pedicle may occur giving rise to an acute surgical emergency that may develop during gestation, labor or puerperium. It may constitute a serious obstacle to delivery, necessitating the performance of cesarean section in order to effect delivery or if the obstacle is not recognized, rupture of the uterus may occur. The cystic tumor may rupture during delivery. Gangrene of the tumor has occurred due to the prolonged pressure upon it during labor.

OCCURRENCE AND PATHOLOGY

A review of ovarian cysts complicating pregnancy by Caverly, of New York, and Lynch, of San Francisco, gave the following statistics: The incidence of this complication ranges from 1 to 500 to 1 in 1,500 cases, while the age incidence is between twenty-eight to thirty years. The occurrence between primaparae and multiparae is equally divided. The majority of the cysts were unilateral and 50 per cent of them were dermoids. It was further noted that 25 to 30 per cent of the cysts were located in the true pelvis and of these pelvic tumors 60 per cent were dermoids, which illustrates the fact that the cyst most likely to remain in the pelvis and obstruct labor is the dermoid.

GROWTH

There is a difference of opinion concerning the growth of ovarian cysts during pregnancy. Some state that there does not appear to be any evidence of specially rapid growth. Others are of the opinion that some rapidly increase after conception. Caverly found a gradual enlargement of the cyst in forty-six cases collected from the literature. Such a case of a rapidly growing cyst is reported in this paper. It is of interest because of the large size attained and because the patient was delivered normally of a live, full-term seven pound baby per vaginam. Eight days postpartum a tremendous simple unilocular cyst was removed containing fourteen quarts of fluid.

SYMPTOMS AND COMPLICATIONS

Often the presence of a cyst causes no symptoms whatsoever, or only moderate discomfort attributed to the usual disturbances of pregnancy. Complications are usually due to rupture, suppuration, torsion and hemorrhage into the cyst. The most dreaded complication is rupture of a dermoid cyst with ensuing chemical peritonitis. Such a case is reported in this paper.

CASE REPORTS

The following three cases were personal cases of the author:

CASE I. Mrs. R. C. F., No. 68667, age twenty-eight, was admitted to Somerville Hospital on December 20, 1941 and discharged March 26, 1942.

This case demonstrates the postpartum complications encountered with a lutein cyst

of left ovary and dermoid cyst of right ovary that ruptured during labor.

This patient was delivered at this hospital

decided to operate after the acute symptoms subsided. She was treated expectantly; a 500 cc. citrated blood transfusion was given on the
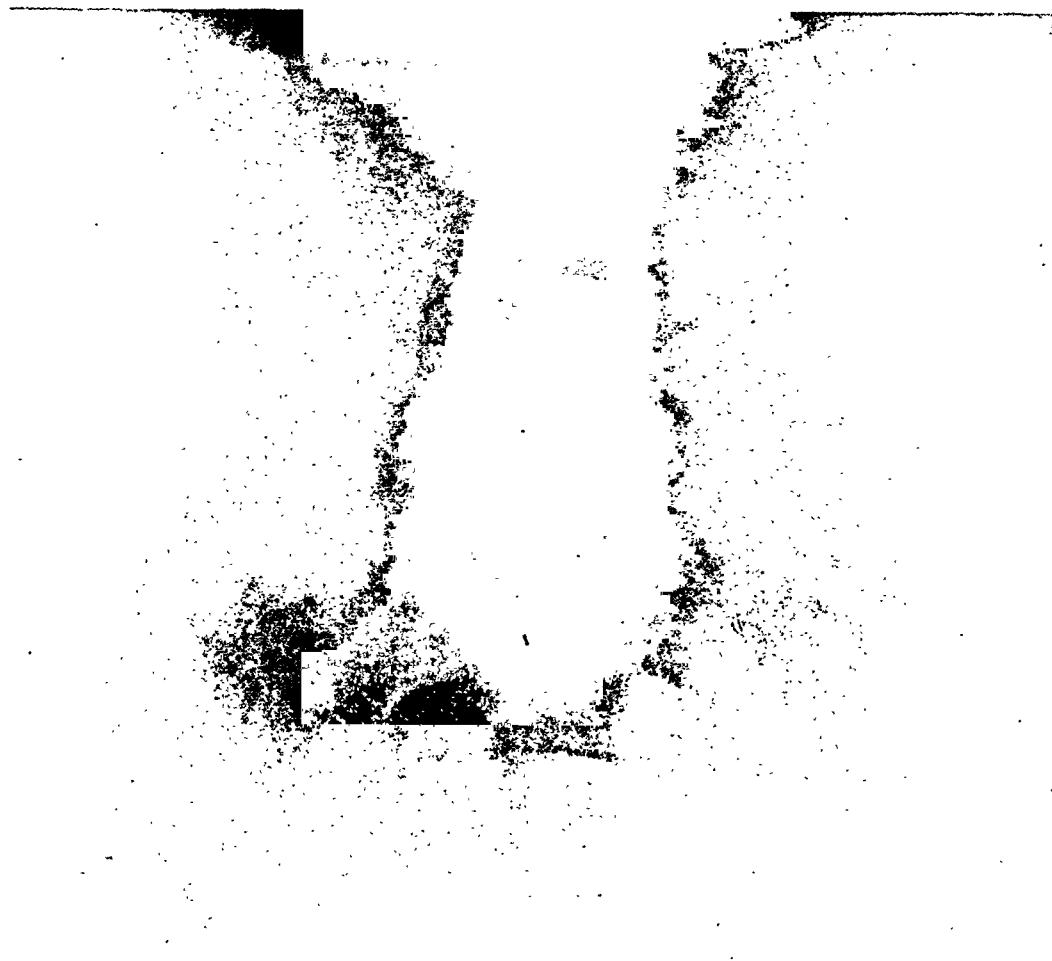
FIG. 1. A, x-ray photograph (anteroposterior view) of Case II taken at eighth month of pregnancy illustrating the abnormal position of the fetus due to pressure of large ovarian cyst on the uterus.

on December 20, 1941, by high forceps, following a hard labor of three days. The immediate postpartum course was uneventful until the twelfth day at which time she began to complain of right lower quadrant pain. Within the next two days there developed generalized abdominal pain, hyperpyrexia and abdominal distention. On the fourteenth postpartum day the temperature was 102.6°F., pulse 128, respiration 32, white blood count 34,600 and sedimentation rate 48 mm. in one hour by Westergren method. Abdominal examination revealed a tender mass the size of a large orange in the right lower quadrant. It was believed at this time that the condition was a pelvic abscess and peritonitis and it was therefore

twenty-sixth postpartum day and 500 cc. on the fortieth day. A sulfathiazole level of 6 mg. per 100 cc. continued for twenty-two days. Her condition gradually improved; on the seventy-ninth day the temperature was 98.4°F., white blood count 9000, red blood count 4,250,000, hemoglobin (Sahli) 88 per cent, sedimentation rate 12 mm. in one hour (Westergren method). At this time pelvic examination revealed a non-tender mass the size of an orange at the right vault; the uterus was fixed. Operation was carried out on the eightieth postpartum day.

Operation was performed on March 12, 1942, under gas, oxygen and ether anesthesia. A midline incision from umbilicus to pubis was

made. The omentum was found to be attached to the anterior abdominal wall and pelvic structures; its separation revealed bilateral

Hospital, on December 27, 1942 and discharged January 16, 1943.

This case illustrates the rapid increase in
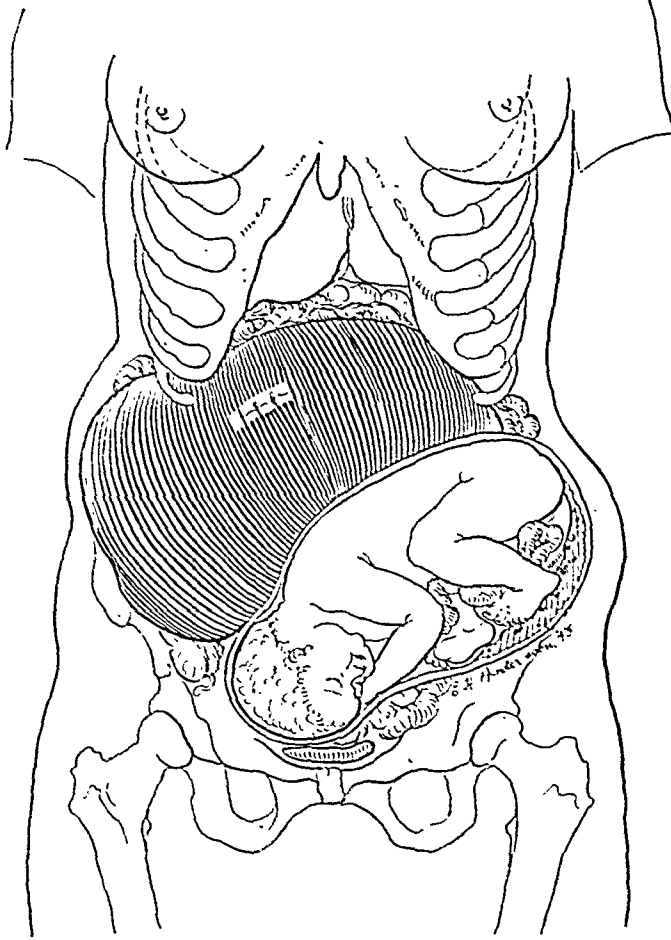
FIG. 1. B, diagrammatic illustration of x-ray Figure 1A.

ovarian masses. Supracervical hysterectomy with double salpingo-oophorectomy was performed together with incidental appendectomy. Sulfathiazole powder, 75 gr., was dusted into the pelvis. The abdomen was sutured in layers. Postoperative convalescence was smooth. The patient was discharged on the fourteenth postoperative day and the incision was well healed. She was last seen in the Out-Patient Department of the hospital on September 8, 1942, at which time it was noted that the patient was well and free of complaints.

Pathological diagnosis stated that there was a dermoid cyst of the right ovary with old rupture, peritoneal implantations and subacute and chronic pelvic peritonitis, involution of the uterus, lutein cyst of the left ovary, and subacute and chronic peri appendicitis.

CASE II. Mrs. O. M. Del., No. 77519, age nineteen, para 1, was admitted to Malden

size that may be attained by an ovarian cyst during pregnancy. It is interesting in that the patient delivered normally a seven pound male at term followed by an ovariotomy eight days postpartum for a cyst containing fourteen quarts of fluid.

The patient was referred to me by Dr. John Verdone, of Medford, in her seventh month of pregnancy with the history that there had been a tremendous increase in the size of the abdomen during the preceding one and a half months. Her only other complaint was moderate dyspnea. Examination revealed a tremendous tense abdomen all out of proportion to the expected size of a seven months' pregnancy; the enlargement was due to fluid that was extra-uterine since the gravid uterus was palpated through the lower abdominal half. X-rays of the abdomen taken on November 20, 1942, (Figs. 1 and 2) revealed the infant

occupying an abnormal position in the lower part of the abdomen due to pressure from a mass overlying it. Diagrammatic illustrations

under gas, oxygen, anesthesia. A midline incision four inches in length was made half way between the umbilicus and pubis. When
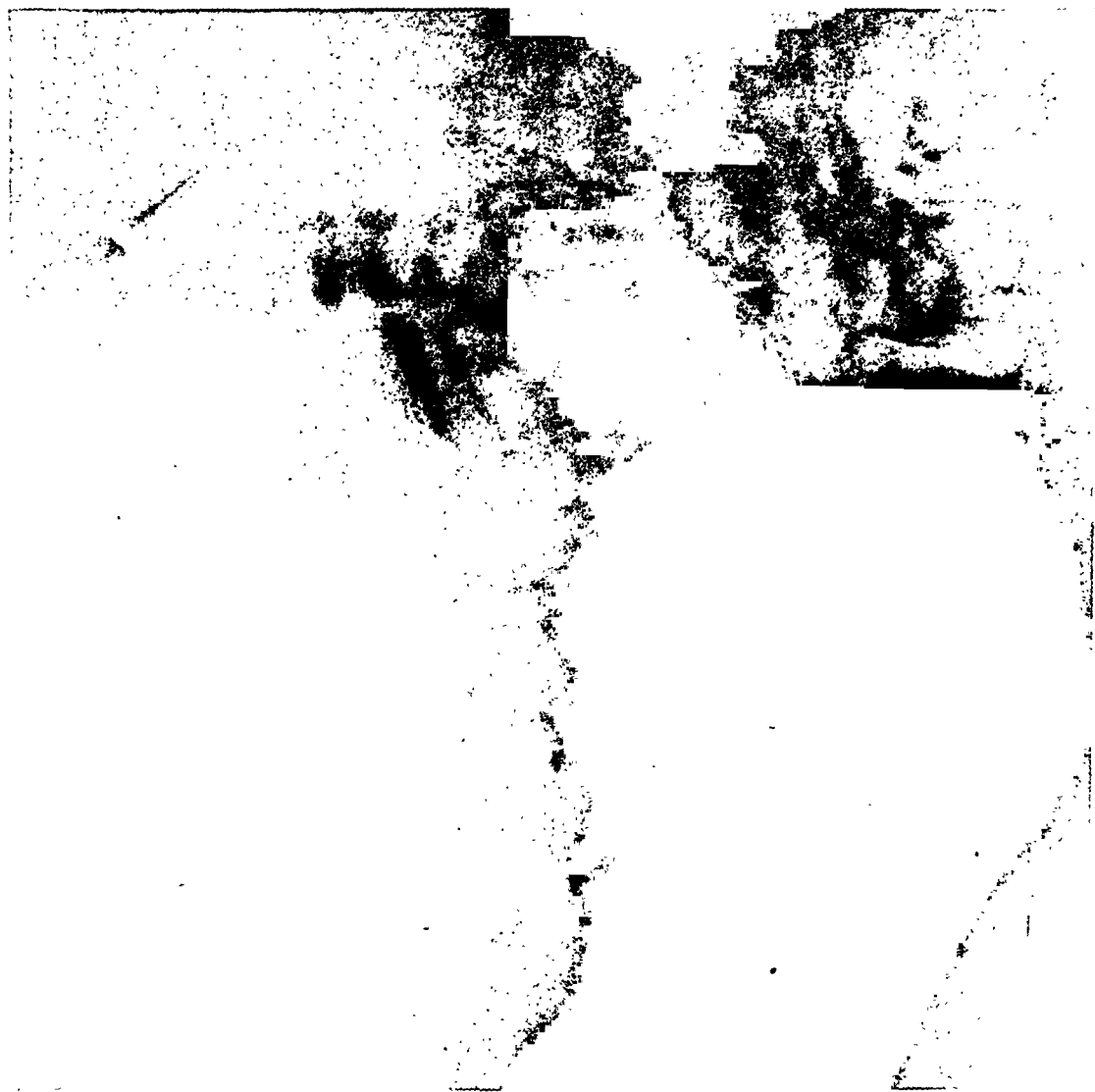
FIG. 2. A, x-ray photograph (lateral view) of Case II again revealing the abnormal position taken by the fetus because of increased pressure upon it by a large ovarian cyst.

(Figs. 1A and 2A) show this condition. Since the patient had no untoward symptoms it was believed best to follow her carefully and await labor with the view of performing cesarean section and ovariotomy if labor was abnormal. She, however, delivered normally a live seven pound male child on December 28, 1942. After delivery the abdomen was still tense and enlarged by a tremendous globular mass occupying the whole abdomen. Operation was carried out on the eighth post-partum day.

Operation was performed on January 5, 1943,

the abdomen was opened it revealed a large tense cyst, filled with fluid, occupying the whole abdomen. The removal of fourteen quarts of clear fluid collapsed the cyst; its sac was then delivered out of the abdomen revealing it to be right ovarian in origin; its pedicle was clamped, cut and transfixed. The right Fallopian tube was removed. Incidental appendectomy was also performed. The left tube and ovary were normal. The abdomen was sutured in layers and the immediate postoperative condition was excellent. Pathological

examination was that of a simple cyst of the ovary measuring 32 by 32 cm. in the flattened state. The cyst was inflated with air (Fig. 3)

history of miscarriage at home on March 7, 1943 followed by the development of severe pains to the right lower quadrant, accompanied
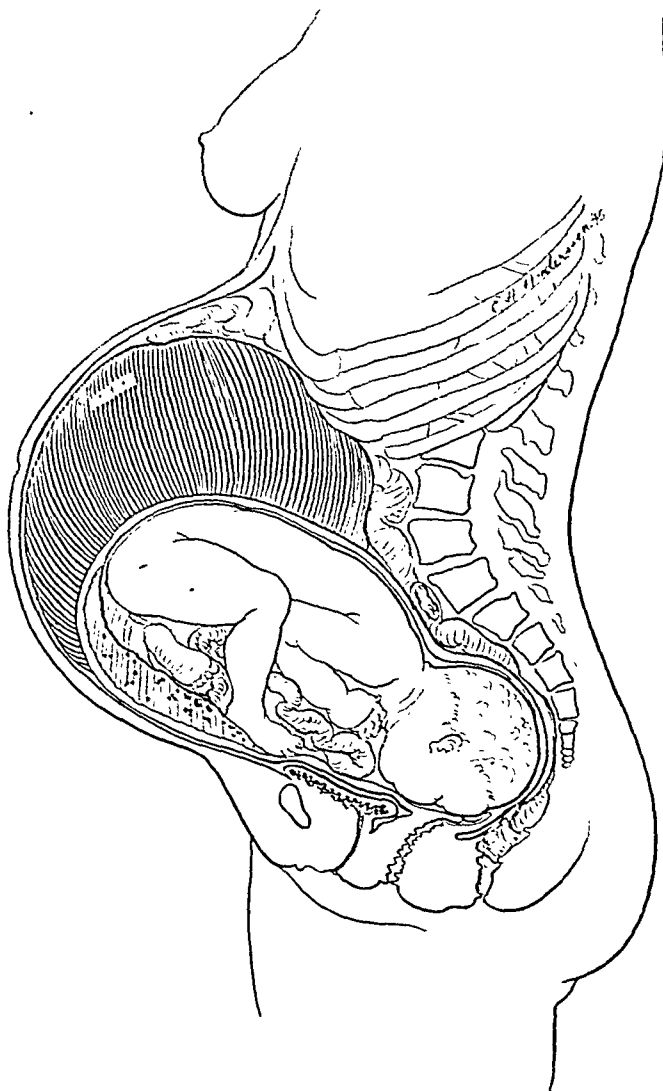
FIG. 2. B, diagrammatic illustration of x-ray Figure 2A.

for photographic purpose. The postoperative course was complicated by P.M. rise of temperature to 101°F. for the first four days due to foul endometrial discharge. She was discharged as well on the eleventh postoperative and fourteenth postpartum day.

CASE III. Mrs. R. DeV., No. 78516, age twenty-nine, was admitted to the Malden Hospital on March 12, 1943, and discharged March 26, 1943.

This case illustrates the possible complication that may occur from an ovarian cyst complicating pregnancy at two months.

This twenty-nine year old female, referred by Dr. J. Verdone, was admitted into the Malden Hospital on March 12, 1943, with the

by pyrexia ranging from 102 to 105 degrees until the date of hospital admission. Examination at this time revealed a well marked, hard, tender mass the size of an orange seemingly attached to the right of the uterine fundus. (Appendectomy had been performed eight years previously.) Laboratory data on the day of admission was white blood count 11,800, 84 per cent polymorphonuclears on smear, red blood count 4,710,000, hemoglobin (S) 94 per cent. A preoperative diagnosis of ovarian cyst with abscess or uterine fibroid was made.

Operation was performed on March 13, 1943, under spinal anesthesia. A midline incision was made. The peritoneum was opened and inspection revealed an ovarian

cyst the size of an orange adherent to the fundus of the uterus. The intestines were packed away from the pelvis with two three-yard strips. The cyst was shelled out from the uterus, and on doing so it ruptured pouring

SUMMARY

1. The presence of an ovarian cyst is not incompatible with normal pregnancy, labor or puerperium.
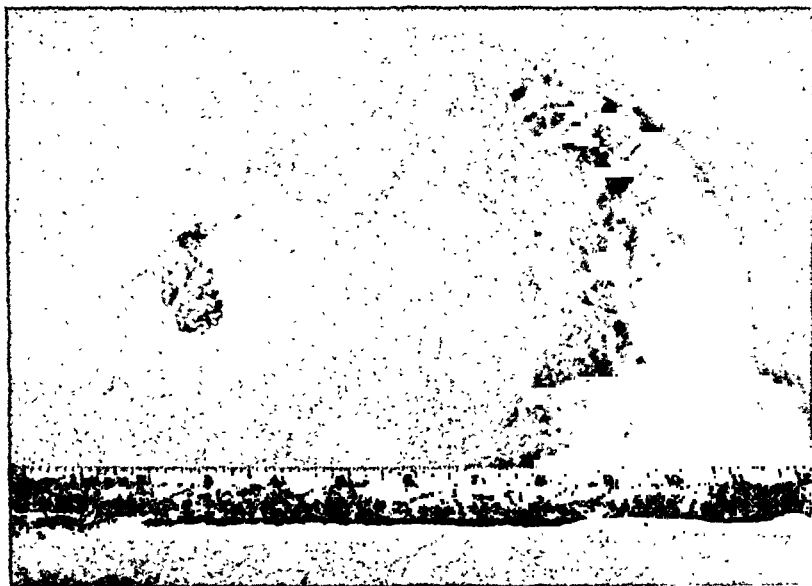
FIG. 3. Photograph of specimen (ovarian cyst) removed on the eighth post-partum day in Case II.

forth thick greenish pus. A culture was taken. Sulfanilamide, gr. 75, was sprinkled about the pelvis and the abdomen sutured in layers without drainage. The immediate postoperative condition was good.

The culture from pus of ovarian cyst, taken during course of operation, was reported on March 15, 1943, as showing growth of hemolytic streptococci.

The postoperative convalescence was complicated by a rise of temperature to 103.8°F. on the sixth day. At this time a probing of the incision was followed by the discharge of about 8 ounces of thick pus, culture of which showed a growth of hemolytic streptococci. The temperature rise promptly subsided thereafter and the patient's condition improved remarkably. Two blood cultures taken during convalescence showed no growth in forty-eight hours and ninety-six hours, respectively. She was discharged on the thirteenth postoperative day.

Pathological report of specimen removed stated that there was an ovarian cyst measuring 8 cm. by 8 cm. in the flattened state. The wall of the cyst was fibrous and throughout it there was an acute inflammatory hemorrhagic process.

2. The usual complications of ovarian cysts occurring in the non-pregnant is more apt to occur in the pregnant.

3. Ovariotomy is indicated in every case of pregnancy complicated by an ovarian cyst. It should not be done during the first three months of pregnancy because of the possibility of removing the corpus luteum which is usually followed by abortion. If the presence of the cyst is first diagnosed in the last months of pregnancy, one of two courses would seem to be indicated: either to wait until full term and then to do a cesarean section and ovariotomy, rather than subject the cicatrix of a recent operation to the strain of labor; or else, if labor and delivery promise to be uncomplicated, to let them occur normally and then to do an ovariotomy early in the puerperium. When the diagnosis of ovarian cyst is first made in the puerperium, ovariotomy should be performed forewith.

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ALBUCASIS gives the first reference to an intra-abdominal pregnancy in the form of a case report. He had seen a pregnant woman whose foetus had died without being expelled. She became pregnant the second time, and again the foetus died. Some time later, the patient developed an umbilical abscess which ruptured, expelling a large number of small bones. She recovered, but the fistulous track remained.

UTEROGRAPHY

AN AID IN THE DIAGNOSIS OF GYNECOLOGICAL PELVIC DISORDERS

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UTEROGRAPHY as a diagnostic procedure is a comparatively new method of diagnosis used in gynecology. Six years ago it was not used in some of the medical schools or in a large number of teaching hospitals. In a survey of the medical publications since 1937 there have been several articles written on the technic of this procedure but only two articles were found published in this country on it as a means of diagnosis. Foreign literature, especially French, Italian, and German during this time have a considerable number of articles relative to this procedure.

It is with the purpose of bringing before the profession a brief résume of the technic, the results and the benefits derived from this valuable procedure that prompted the author to write this article.

Material for this paper was taken from a review of a hundred unselected cases from the files of a clinic, these cases occurring during the year 1940. It is admitted that this is a comparatively small number of cases from which to draw conclusions, but it is representative. Since 1935, this procedure has been used extensively in this clinic and over this period of time several thousand cases have been examined. It is also conceded that these results are not too definite, for histories were often incomplete and personal evaluations are prone to creep into a reviewer's interpretations.

Equipment. The equipment necessary for this procedure is an x-ray machine equipped with a Potter Bucky diaphragm, cassetts and: (1) small uterine sound, (2) cervical tenaculii—two, (3) uterine cannula equipped with a rubber tip on one end

and a syringe connection on the other, (4) a 10 cc. syringe, and (5) 10 cc. of heavy brominal.

The choice of radio-opaque material is of some concern. The substance should be non-toxic, be quite quickly absorbed in the peritoneal cavity, give good contrast, and not be too thick causing difficulty in going through the tubes, neither should it be too thin so that it will flow too readily out of the tubes before pictures may be taken. Lipiodol has been used for this but it is absorbed very slowly, and there is some proof that it may produce some irritation of the tubal epithelium. Titus[1] and others recommend the use of a mixture of diodrast or neo-i-opax and acacia, or sterile lubricating jelly. They have shown it to be non-toxic and it is absorbed in about four hours. The heavy brominal was used in these cases studied in this clinic and it was found to be quite well absorbed in twenty-four hours. No undesirable after-effects have been noted in the cases in which this substance has been used.

Technic and General Consideration. Before this procedure is undertaken, a thorough history and physical examination should be made. A big contraindication for this procedure is pregnancy, and although one may watch for this condition diligently to avoid doing this procedure at such a time, occasionally a pregnant uterus will be injected. This was done accidently in two cases in the series observed; one of these went to term without interruption while the other had a miscarriage shortly after the procedure. A third case had symptoms very suggestive of a miscarriage after a uterography and a placental-like mass was extruded which proved to be a

degenerating fibroid. Apparently the procedure caused it to loosen its attachment to the uterus.

time. A roentgenogram is taken immediately after each injection. The usual number of x-ray exposures is three or four,
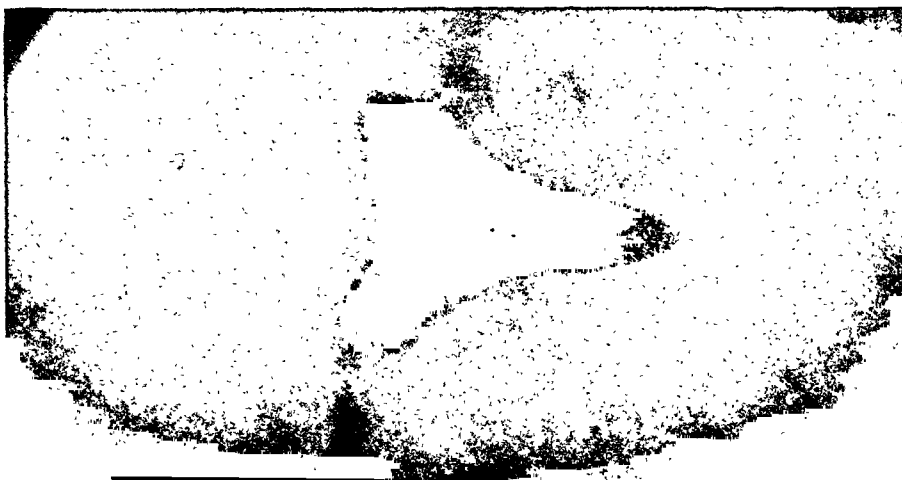
FIG. 1.
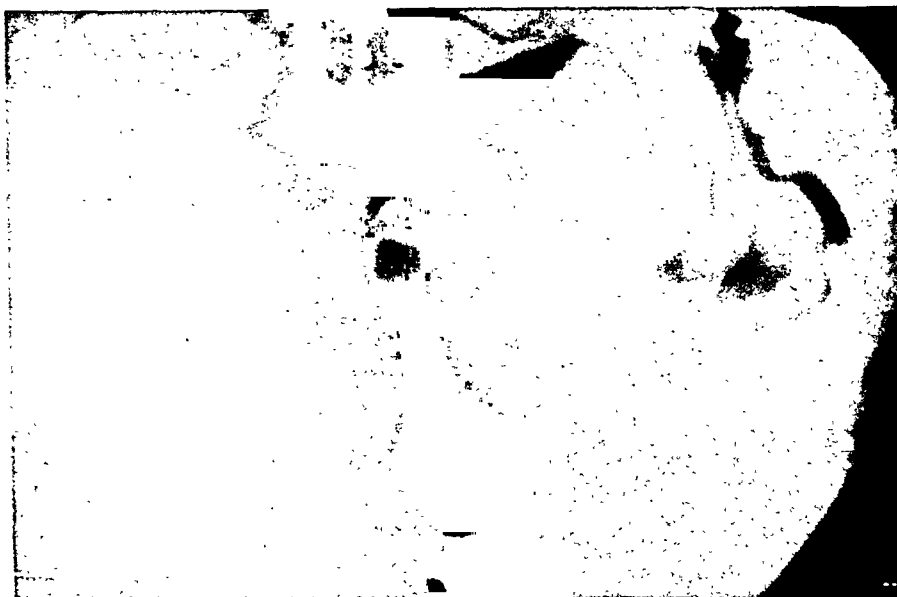
FIG. 2.

FIG. 1. Normal uterogram. Note the smooth uniform uterine cavity, narrow cervix and string-like lumen of the Fallopian tubes.

FIG. 2. Intrauterine polypii, hydrosalpinx grade 1 and endocervicitis. Note the dilated cervical canal with roughened borders, the two polypii or submucous fibroids in the lower segment of the uterus and the smooth sausage-like dilatation of the end of the Fallopian tube on the left. The right tube did not fill; it was probably occluded by previous inflammatory disease.

With the patient in lithotomy position the cervix is exposed and grasped with the tenaculii and the cervical canal explored with a small sound. The tip of the uterine cannula is inserted into the cervix pushing it firmly up to the rubber stopper and held in place with the two tenaculii. About 2 cc. of the opaque material is injected at a i.e., three anterioposterior and one lateral. Delayed emptying time of the material from the uterus or the Fallopian tubes may be checked at twelve to twenty-four hours after the injection. Normally they empty in twelve hours. Anesthesia is not necessary for this procedure, but occasionally for the nervous patient $\frac{1}{6}$ gr. of morphine

or one of the barbiturates aids greatly in this procedure. It is difficult or almost impossible to inject the radio opaque liquid

charge, irregular menses and intramenstrual bleeding. These complaints are the most cardinal symptoms of carcinoma. These
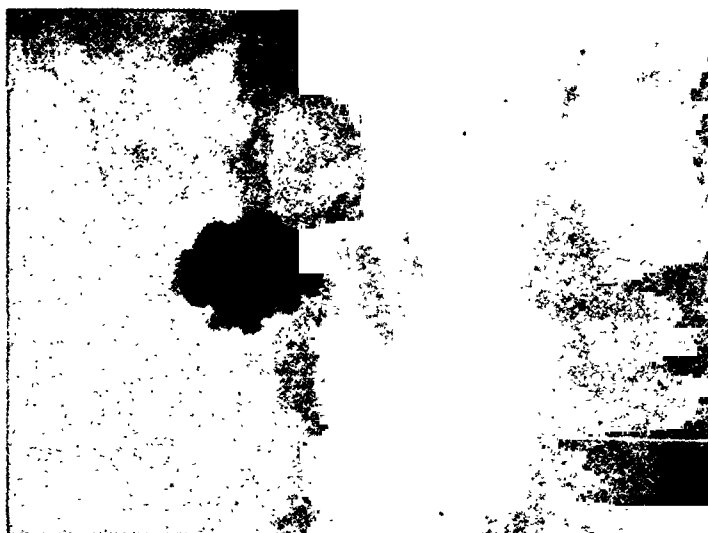
FIG. 3. Hydrosalpinx on the left with normal spill of opaque material with puddling in cul-de-sac on the right. Note the smooth bordered sacular outline of the dilated tube on the left.

into the cervical canal of a frightened or apprehensive patient. Undue force should not be used. Gentleness and patience will be rewarded by many more successful injections than will be obtained by a forceful procedure. This is an office procedure; however, the patient should not travel any great distance immediately following it and should remain quiet preferably in bed for at least twenty-four hours afterward.

ANALYSIS OF CASES

In this study it is worthy of note that there were nearly twice as many diagnoses listed under x-ray departmental diagnoses as compared with that made by the clinician's diagnosis, and the x-ray diagnoses were much more specific.

Menorrhagia in some form or other is the most common single complaint found present in 16 per cent of the cases. Vaginal discharge came next, and irregular menses third in 10 and 8 per cent, respectively. Thirty-seven per cent of the chief complaints were menorrhagia, vaginal dis-

are some of the most common complaints a gynecologist hears. He should have some sure and easily performed diagnostic procedure to make or disprove the diagnosis of carcinoma.

A diagnosis of endocervicitis was listed in 16.5 per cent of the cases examined by x-ray as compared with 2 per cent having this condition in the clinical diagnosis. This is suggestive that this condition is present much oftener than is diagnosed clinically, and probably is responsible for more symptoms than it is credited with. Clinically, the diagnosis of pelvic inflammatory disease was made in 12 per cent of the cases, while the final diagnosis of salpingitis was made in only 6 per cent. The correction of the clinical diagnosis was made by surgery or x-ray. It is suggestive that this diagnosis is made too often in general practice. A diagnosis of salpingitis or hydrosalpinx was made in 7 per cent of the cases by x-ray. Most of these cases were of such degree that it would be impossible to feel the adnexa and diagnose the disease bimanually. The x-ray diagnosis of hydrosapinx and salpingitis given by

surgery closely corresponds, i.e., 7 per cent and 6 per cent, respectively.

A study was made of the final diagnosis as determined by operation, biopsy and by summary of the patient's chart. It is in the latter group in which the big error is likely to be present, for incomplete charts and follow-up records make conclusions almost worthless. It is in this group that a fair number of "undetermined" final diagnosis was made. The diagnosis, menopause, was made in those cases of that age group who had symptoms that were of the menopausal type and in whom some pathological condition could not be found. This occurred in 8 per cent of the cases. The clinical diagnosis of this condition was made in 2 per cent of the cases. Undoubtedly, the examining physician made a mental diagnosis of menopause at the time of his examination in a much higher per cent of the cases, but it is the practice of this clinic to make the diagnosis only after all other pathological disorders have been ruled out.

Intra-uterine polypii were present in 9 per cent of the total x-ray diagnoses. This condition cannot be accurately diagnosed clinically. In a study of these individual cases, the predominating symptoms were menorrhagia, metorrhagia and dysmenorrhea. When these symptoms occur in the younger age group intra-uterine polypii should be suspected more frequently.

In a comparison of clinical diagnosis and x-ray diagnosis, the records show a close approximation in the diagnosis of the normal uterus and tubes, i.e., 24 per cent and 22 per cent, respectively. Also the clinical and x-ray diagnosis of enlarged uterus of 15 per cent and 17 per cent, respectively, is verys imilar. There is a considerable difference in the clinical diagnosis of fibroid uterus and x-ray diagnosis of the same, i.e., 17 per cent and 5.6 per cent, respectively. However if one combines the x-ray diagnoses of uterine tumor of 9.9 per cent and fibroid uterus of 5.6 per cent, a total of 15 per cent is obtained which closely agrees with the clinical

diagnosis of 17 per cent of the cases of this disease. Perusal of these two groups of cases shows they are not the same cases.
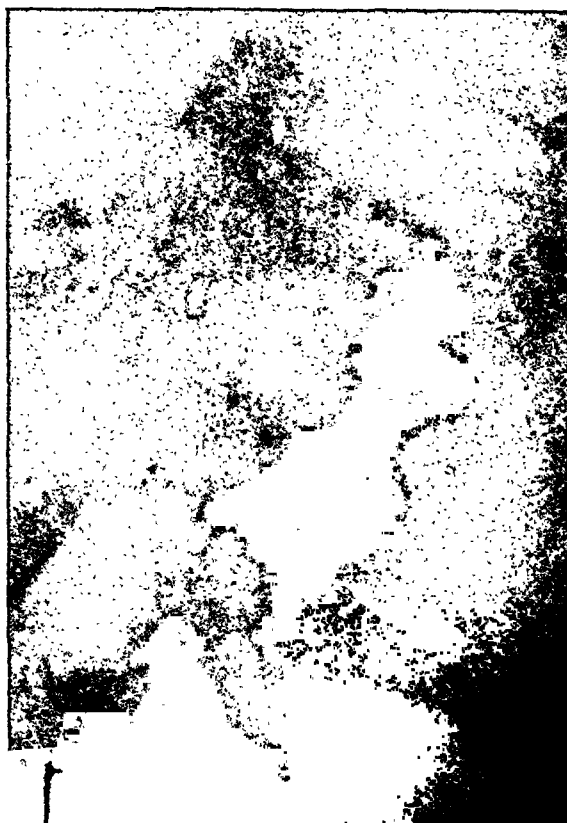
FIG. 4. Adenocarcinoma of the cervical canal. Note the marked irregularity and deformity of canal and uterine cavity. This is a characteristic picture resembling that seen in a roentgenogram of carcinoma in any cavity of the body.

It is admitted that the x-ray is of no great value in the diagnosis of fibroid uteri when such is large and easily outlined by the physical examination, but this is not true for the small or submucosal tumors.

COMMENT

Diagnostic procedures should be safe, readily available, comparatively simple to perform, exacting, and convincing to both doctor and patient. Uterography as a diagnostic method falls into this category.

Uterography is an office procedure requiring a relatively short time to perform and does not incapacitate the patient appreciably. When compared to the cost of curettage in a hospital, hospitalization and laboratory expense, it is a big saving

to the patient. There are many patients who will refuse to enter the hospital because of financial circumstances, aversion

in which there might be some question whether the uterus should be removed or not, or before an interposition operation
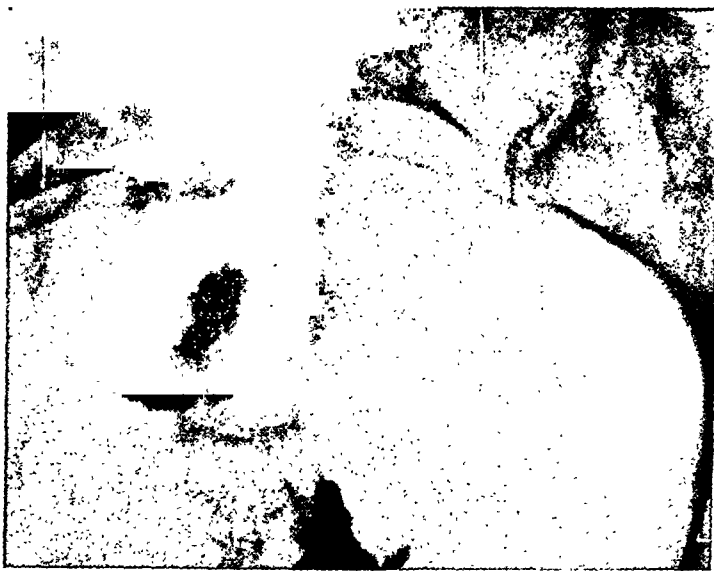
Fig. 5. Intramural fibroid of the uterus. Note enlarged deformed uterine cavity with displacement of opaque material in the center. This tumor could not be palpated by bimanual examination. The clinical diagnosis was "Uterus somewhat enlarged, cause?"

to hospitals or other reasons but few will refuse to submit to x-ray examinations. As shown above it is quite a reliable procedure, probably just as much so as that of curettage, for small lesions might well be missed by curettment. The large or late lesion is quite easily and accurately diagnosed by most methods. It is the small early lesion that is unfortunately easily missed. As a result of its low cost and ease of performance, suspicious lesions can be followed by recheck examinations at short intervals. Few patients will submit to two or more curettages in a relatively short time; most patients will return for x-ray study without urging if they know they have a suspicious lesion present in their body as demonstrated by an x-ray film. Roentgenograms taken at intervals make a valuable graph of the patient's progress. Shown to the patient her confidence in her physician will grow and his advice will be followed more diligently.

This procedure is of great value in ruling out pathological disorders preparatory to operative procedures, such as a laporatomy

in an elderly patient. It can be a deciding factor whether to do a hysterectomy in a given case or to give x-ray therapy for fibromyomas of the uterus.

The diagnosis of carcinoma of the cervical canal or fundus of the uterus can be made or ruled out for the cautious doctor or for the cancerphobia patient. Both doctor and patient can rest assured of no serious disorder as shown by a normal uterogram.

Patent or closed tubes as shown by this procedure aid in the diagnosis of sterility. The clinic in which this study was made has observed that pregnancy followed uterography in a fair number of cases in which it had been used as a diagnostic procedure to determine the cause of sterility. It is gratifying to the wishing "would be mother" to know that her pelvic organs are normal. This information may cure some neurosis or iron out some family difficulties.

In the diagnosis of carcinoma of the cervical canal or fundus this procedure has been very reliable. In one case in

which the x-ray diagnosis was a carcinoma of the fundus, the surgeon made a similar diagnosis from the gross specimen and it was not until the pathological report came back as, "Hypertrophic polypoid endometrium" that the correct diagnosis was made. Here probably curettage would have been the better procedure but such cases are rare indeed.

In the treatment of carcinoma elsewhere in the body the surgeon does not first curette the lesion and then remove it. Why then with this condition present in the cervix of the uterus should curettage be recommended when there is an equally reliable and safer method available? It is the contention of this clinic that there is little or no danger of dissemination of cancer cells by uterography, while curettment, even when followed by immediate hysterectomy, is quite likely to spread the deadly disease.

Where uterography is followed by curettment in a case in which a polyp is known to be present, curettage is likely to be done more thoroughly and properly if the surgeon knows ahead of time what is present and where the lesion is to be found.

The argument that the procedure may introduce infection into the uterus and the pelvis or light up an old latent infection already present is a real one. However, in patients who were operated upon shortly after uterography had been done, no definite evidence of infection was present. Also there were no cases of pelvic infections following surgery. Occasionally, patients were made uncomfortable with considerable pelvic distress for a few days following the brominal injection. This clinic has never had a mortality from this procedure. There has been no oil emboli at any time.

The roentgenograms in the figures are only representative of certain lesions. Most uterine lesions can be diagnosed quite easily by anyone having an average amount of training in roentgenographic interpretation. As in all procedures, practice makes perfect; numbers of uterograms viewed will bring confidence and perfection.

CONCLUSIONS

1. Uterography is a safe, useful method to use as an aid in the diagnosis of gynecological disorders. Its use will result in a much greater accuracy and specificity of diagnosis. Its use will reveal intra-uterine disorders earlier and easier than any other single diagnostic measure the medical profession has to date.

2. Due to the lessened cost and convenience to the patient as compared to curettage many more examinations will be made where this procedure is used. It is only by being thorough in one's diagnostic methods that a late, undesirable end result with its morbidity and mortality can be prevented.

3. A good history and physical examination gives a high percentage of correct diagnosis in conditions such as, fibroid uterus, enlarged uterus and gross adnexal disorder, but falls short in the diagnosis of endocervicitis, intra-uterine tumors, carcinoma, and the chronic forms of adnexal disease in which the pathological process is not readily palpable.

4. As in all technical procedures, this is an aid to diagnosis and not a supplement to a history, physical examination and good clinical judgment.

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SULFATHIAZOLE THERAPY IN GENERAL SURGERY

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A SIGNIFICANT feature of modern surgery is the widespread interest and activity displayed in the study and investigation of the causes of post-operative morbidity and mortality. The combined resources of the medical and collateral sciences have been called upon to discover causes of surgical morbidity and to aid the surgeon in finding safeguards for the protection of the patient before, during and after operation. As a result of such research new principles, methods and therapeutic suggestions have arisen.

Sulfonamide therapy is a most recent product of such research. Its application to surgical disorders is based upon a sound surgical principle. The sulfonamides are bacteriostatic agents. Chemotherapy is not a substitute for well established surgical principles but is an additional weapon used in the constant battle against infection.

A clinical survey of 207 sulfathiazole treated surgical patients is presented. Sulfathiazole, the thiazole derivative of sulfanilamide, was selected as the chemotherapeutic agent of choice for the following reasons: (1) Very few surgical reports concerning the drug were available at the time this study was undertaken, this being the newest addition to the chemotherapeutic group of drugs. (2) The wide range of usefulness of sulfathiazole from a bacteriologic viewpoint as compared with sulfanilamide and sulfapyridine. (3) Experimental evidence by Reinhold, Flippin and Schwartz[1] proving that its use therapeutically is more easily controlled, because sulfathiazole is absorbed more readily and excreted more rapidly than sulfapyridine. (4) Acute toxicity of sulfathiazole is about half that of sulfapyridine, according to the results of Long, Perrin, Haviland, James and Edwards.[2]

MODE OF ACTION

Various reports have appeared concerning the mode of action and therapeutic activity of the sulfonamide compounds. Long and Bliss[3] in one of their original articles showed that sulfanilamide in certain concentrations, when placed in contact with cultures containing beta hemolytic streptococcus definitely inhibited multiplication of the organisms. Long and Bliss[4] in a later report conclude that there is no bactericidal effect in the action of sulfanilamide and decide that the serums of patients treated with sulfanilamide exert little if any bactericidal effect on beta hemolytic streptococci. There is a definite bacteriostatic effect *in vitro* as well as *in vivo* and these authors ascribe to phagocytosis the so-called clean-up roll.

J. S. Lockwood[5] has demonstrated that phagocytosis is not necessary to interfere with bacterial growth. Interference takes place to the same extent in human serum which contains no phagocytes. He has also shown that the presence of peptone is important in the action of sulfanilamide. He concludes that sulfanilamide acts upon hemolytic streptococci by interference with their protein digesting mechanism. This accounts for the fact that sulfanilamide is of greatest value in lesions in which there is a minimum of tissue destruction. In a later and comprehensive report Lockwood[6] comes to the following conclusions: "This bacteriostatic effect is probably a result of a specific interference with the enzymatic utilization by the bacteria of some nutritive chemical factor, such as P-Amino-benzoic acid, these substances, the utilization of

which is blocked by sulfonamide, will act as inhibitors of sulfonamide effects when they are present in more than minimal concentrations."

DOSAGE AND ROUTES OF ADMINISTRATION

No attempt was made to adhere to a rigid dosage schedule. The necessity of administering the drug in doses sufficient to bring about the therapeutic effect was particularly emphasized. The following figures cite in a general fashion the dosage utilized in this series of surgically treated cases. Severe infections, such as, staphylococcic cellulitus, lymphangitis, and severe cases of peritonitis received an initial dose of 3 Gm. of sulfathiazole. This dosage was repeated in four hours followed by doses of 1 Gm. every four hours, day and night, as long as evidence of a spreading infection continued. Drug therapy was discontinued forty-eight to seventy-two hours after subsidence of the infection. In moderately severe infections an initial dose of 2 Gm. was given. This dose was repeated in four hours, following which 1 Gm. doses were administered every four hours. Therapy was continued in many of these cases for a period of two to five days after all clinical evidences of the disease had disappeared.

The dosage of sulfathiazole crystals locally implanted in wounds varied from 0.5 to 12 Gm. The extent and severity of the wound serving as a guide to dosage.

Sulfathiazole is readily absorbed when given by mouth. It is also rapidly distributed in the tissues and body fluids, with the outstanding exception of the cerebrospinal fluid. As a result, the oral method of administration was favored in all these cases. Utilization of intravenous sodium sulfathiazole was reserved for the immediate postoperative period and for those cases in which drug therapy was not tolerated by mouth. The dosage schedule for intravenous therapy did not vary from that procedure as described above. The sodium salt of sulfathiazole in amounts of 2 or 3 Gm. was dissolved in 500 cc. of distilled water. A dosage of 1 Gm. was

dissolved in 100 cc. of distilled water. These were given by the slow continuous drip method. Alkali therapy so often administered with sulfathiazole was omitted in this series of cases.

LABORATORY STUDIES

Complete blood counts and hemoglobin determinations were routinely performed on admission of the patient to the hospital. These studies were repeated daily or every second or third day, depending upon the status of the individual case. Determinations of sulfathiazole concentrations in the blood were carried out daily in a majority of these patients. These concentrations varied from 5 to 15 mg. per 100 cc. of blood. Concentrations in the blood plus the general clinical survey of the patient served as a guide to control the administration of the drug.

Routine urine analyses were performed on admission. Gross examination of the urine was performed daily in all cases. Chemical and microscopic examinations were performed every second or third day. Particular attention was directed toward the observation of gross or microscopic hematuria. Maintenance of an output of 1,000 cc. or more of urine in twenty-four hours was particularly stressed. Other laboratory procedures were utilized as indications in individual cases demanded. These included blood cultures, blood chlorides, plasma protein, carbon dioxide combining power, prothrombin determinations, etc.

CLINICAL USE

A total of 207 surgical cases were treated with sulfathiazole. For purposes of discussion these cases are divided into the following groups: (1) Peritonitis of appendiceal origin; (2) traumatic wounds; (3) lymphangitis and cellulitis; (4) carbuncles; (5) burns; (6) chronic leg ulcers. This grouping is based upon a clinical and pathologic diagnosis. According to Lockwood[7] the pathologic character of the

infectious lesion is of primary importance in determining the effectiveness of sulfonamide therapy.

Peritonitis of Appendiceal Origin. One hundred and ten patients presenting peritonitis associated with appendicitis comprise the largest group. These patients were observed twice daily. Particular attention was directed toward any possible toxic effects resulting from the administration of sulfathiazole. Other needs of these surgical patients from a modern surgical viewpoint were duly considered in each instance. These included surveys directed toward maintenance of proper fluid, electrolyte, protein and vitamin balance. Ravdin[8] in a recent report states that "no consideration of fluid and electrolyte loss and their restitution is sufficient unless the plasma protein is simultaneously considered." This viewpoint was considered in treating these patients. Blood or plasma transfusions were administered to meet individual requirements in which anemia and hypoproteinemia were factors.

Five per cent glucose solutions in normal saline were utilized by the continuous drip method, giving nothing by mouth, in severe cases. Suction drainage, oxygen and vitamin therapy were employed to meet individual demands. Oxytocic drugs were avoided. Morphine was routinely administered. Orr[9] concludes that morphine stimulates rhythmic contractions of intestinal muscle and raises the muscle tone as evidenced by increased intraluminal pressure. However, this same author[10] in a later report concludes that morphine may be given with assurance in the treatment of peritonitis not only to increase muscle tone but to make the patient comfortable, promote rest, relieve anxiety and minimize thirst.

Positive cultures for the following organisms were obtained, Bacillus coli, Streptococcus hemolyticus, Streptococcus non-hemolyticus, and staphlococcus. No attempt was made to classify these cases into local, spreading or general peritonitis. Ravdin, Rhoads and Lockwood[11] believe

that little can be gained from such a classification since the most important problem in appendicitis is infection. The difference between the various types being one of degree.

Appendectomy was performed in all of these cases. Drainage was used in thirty-two cases. One patient died in this group, a mortality rate of 0.9 per cent. A similar series of 130 cases of peritonitis were

TABLE I

CLINICAL CLASSIFICATION OF 207 SURGICAL PATIENTS TREATED WITH SULFATHIAZOLE

Indications	No. of Patients
Peritonitis of appendiceal origin....	110
Traumatic wounds................	49
Cellulitis and lymphangitis........	19
Burns.........................	7
Carbuncles.....................	5
Chronic leg ulcers................	17
Total........................	207

analyzed for comparison. Appendectomy was performed in each case. Drainage was employed in fourteen cases. All factors were constant with the exception that sulfathiazole therapy was omitted in this latter series. There were three deaths in this series, a mortality rate of 2.1 per cent. Convalescence was smoother in the sulfathiazole treated patients. Sulfathiazole treated patients were hospitalized for an average period of 4.5 days less than the untreated series. A lowering of the mortality rate, and a very definite decrease in the morbidity rate is revealed as a result of this analysis between sulfathiazole treated and untreated patients with peritonitis of appendiceal origin.

Intraperitoneal implantation of sulfathiazole was not utilized in this series. That the mortality and morbidity rate might still be more favorably influenced by this procedure is highly encouraging. Rosenberg and Wall[12] believe that sulfanilamide is not irritating to the peritoneum and that it is advantageous in obtaining a high concentration of the drug in the peritoneal cavity at the time of and immediately following operation. Mueller and Thompson[13] report a series of 268

patients with acute appendicitis treated by intraperitoneal therapy without a death. Jackson and Coller[14] state that there is no evidence that local application intraperitoneally injures the peritoneal surfaces, and suggest that chemotherapy offers promise of reducing adhesion formation in the peritoneum secondary to pyogenic infection.

Traumatic Wounds. It has been established by Jensen, Johnsrud and Nelson[15] that under certain conditions there are distinct advantages in applying sulfonamide compounds directly to tissues. Diveley and Harrington[16] more recently reported a series of fifty-six cases with infected bones and soft tissues treated by both systemic administration and local implantation of sulfathiazole with highly successful results. The chief virtue of such a procedure according to Spink and Paine[17] is that it provides much higher concentrations of the drugs in a relatively small area than can be obtained when the drugs are administered orally or parenterally. These higher concentrations may overcome, at least in part, factors that inhibit the antibacterial action of the compounds. According to Lockwood[6] the curative effects of sulfonamides are maximal when the concentration of the drug is high, when the local cellular defense is active, and when the concentration of sulfonamide inhibitors in the infected area is low.

In order to obtain this optimum therapeutic result in these forty-nine patients presenting traumatic wounds, the following principles and procedures were followed: Attention directed toward the general supportive care of the patient; débridement and irrigation of the wound; immobilization of the affected area; sulfathiazole locally applied, and supplemented by oral administration in most cases. Infection developed in the first of five compound fractures treated. Difficulty was experienced early in treating these traumatic wounds. The first case treated by local chemotherapy was a traumatic wound of the back. Following adequate débridement

and irrigation the wound was sprinkled with sulfathiazole. The wound was closed and the drug placed along the suture line in order to prevent a stitch abscess. Solidification of the drug plus trauma from movements while sleeping produced a mild pressure necrosis of the skin. This practice was discontinued for those regions which could not be properly controlled. Solidification (caking) of sulfathiazole producing interference with wound healing was experienced in the first six patients treated. Removal of the drug resulted in satisfactory closure. An excess amount of serum was encountered in five wounds. This was expressed and convalescence was uneventful. This early experience with caking of sulfathiazole in the wound brought up these questions: Does sulfathiazole as a result of solidification act as a local mechanical irritant? Does this process alter the local absorption of the drug? How can this effect be overcome? Will minimum implantation locally plus oral therapy prove adequate in providing a sufficiently high local concentration of the drug to prevent or overcome existing infection?

As a result of this early experience the patients who followed were treated locally with much smaller amounts of the drug, supplementing the drug by oral administration. This solved the annoying problems which were presented. Satisfactory results were obtained. There was no interference with wound healing and no infections were encountered following this procedure. Ferguson,[18] in a recent report, states that this new preparation, microsulfathiazole, will eliminate these objectionable features observed when sulfathiazole is applied locally in wounds.

Cellulitis and Lymphangitis. The results of therapy in nineteen patients with cellulitis and lymphangitis were unusually satisfactory. Two patients with cellulitis had severe attacks of the disease with extensive involvement, edema, high fever and toxemia. Blood cultures were all negative. Treatment consisted of intensive doses of

sulfathiazole maintaining a high concentration of the drug. General supportive measures combined with immobilization, elevation and the application of wet dressings were employed. Surgical interference was avoided. A definite improvement was noted forty-eight hours following chemotherapy. There were no deaths in this group.

Carbuncles. Five patients presenting large carbuncles were treated by surgical excision. There was a striking difference in response relative to healing between the two patients treated locally with chemotherapy and those packed with vaseline gauze only. This latter group required on an average of eight days longer for complete healing. The wounds looked cleaner and the patients were more comfortable when treated by local sulfathiazole therapy. According to Lockwood[6] localized areas of tissue necrosis and abscess contain large quantities of sulfonamide inhibitor. The organisms within such lesions are protected against the effects of sulfonamides. Of great importance is the surgical treatment of sulfonamide resistant lesions.

Burns. This group consisted of seven severely burned patients. The early management of these patients consisted of débridement, tanning and the use of thermoregulated heat over the affected area. Plasma transfusions and adrenal cortical extract as advocated by Rhoads, Wolff and Lee[19] were also administered. Three of these cases became infected. Sulfathiazole was applied sparingly to the denuded surface because of the possible danger of too rapid absorption of the drug. Skin grafts were successfully used in these cases after the field had been treated by chemotherapy. A fourth patient presenting slight evidence of infection over a large burned area of the trunk and upper extremities was considered as a possible case for local sulfathiazole therapy. However, due to large denuded areas present in this child of six years of age, fear was expressed concerning rapid absorption of the drug

resulting in toxic manifestations. As a result sulfa therapy was not used. The child died suddenly twenty-one days following the burn. Postmortem examination revealed the presence of multiple perforated stomach ulcers, non-perforated duodenal and jejunal ulcers, and peritonitis. An acute ulcer of this type occurring in the duodenum is called a Curling's ulcer. These acute ulcers according to DaCosta[20] occur late following an extensive burn and are probably due to sepsis. Sulfathiazole therapy might have prevented a fatality in this patient. Of equal importance is the finding of this rare ulcer.

Chronic Leg Ulcers. These lesions are commonly the site of low grade mixed infection. The purulent stage in seventeen chronic leg ulcers were controlled by applying sulfathiazole directly over the wound. Epithelialization was hastened in two cases by placing pinchgrafts in the granulating area. Saphenous ligation preceded local chemotherapy in five instances. The results in this group were highly satisfactory.

TOXIC EFFECTS

Toxic symptoms referable to sulfathiazole therapy were comparatively rare and mild. They were noted in twenty-seven, or 13 per cent of the 207 patients treated. There were no deaths in this series as a result of toxicity from sulfathiazole therapy.

Nausea and Vomiting. During sulfathiazole administration nausea and vomiting were noted in 2.9 per cent of the patients. In no instance was this symptom severe enough to necessitate discontinuance of the drug.

Cyanosis. This was observed in 4.8 per cent of the patients. This was of a mild degree in all cases. No difficulties were experienced from this source.

Drug Fever. The appearance of this toxic manifestation occurred in 2.4 per cent of the patients. This was sufficient reason to discontinue the drug and force fluids.

Dermatitis. This was observed in three patients. Dermatitis appeared between

the sixth to the ninth day of therapy. These cleared up with the discontinuance of the drug.

Leukopenia. A drop in the leukocyte count to below 4,000 per cubic millimeter was noted in two patients. This occurred early in our series. The drug was continued without producing any serious disturbances. Long et al.[21] state that no deaths have been reported from disturbances of the white cells during the first twelve days of chemotherapy.

Hematuria. Microscopic hematuria was noted in one patient on the eighth day of therapy. Gross hematuria was not observed in any of these patients. Chemotherapy was discontinued in this patient. Convalescence was uneventful.

Acute Agranulocytosis. This rare toxic manifestation was not encountered in this series. It is of interest from the viewpoint that no deaths from acute agranulocytosis were reported following sulfathiazole therapy up to June, 1941. At this time Hoyne and Larimore[22] reported the first uncomplicated case in which acute agranulocytosis developed after prolonged medication with sulfathiazole, terminating in death.

TABLE II
INCIDENCE OF TOXIC REACTIONS (207 CASES)

Toxic Effect	No. of Cases	Per Cent
Nausea and vomiting, mild...........	6	2.9
Cyanosis, mild.....................	10	4.8
Dermititis........................	3	1.4
Drug fever*......................	5	2.4
Leukopenia.......................	2	0.9
Hematuria, microscopic*..........	1	0.5
Hematuria, gross.................	0	0.0

* Drug discontinued, fluids forced.

CONCLUSIONS

1. Rigid adherence to surgical principles must be followed in all instances in which chemotherapy is employed.

2. Surgery combined with sulfathiazole therapy has reduced the mortality and morbidity rate in peritonitis of appendiceal origin.

3. Surgical lesions characterized by a minimum of tissue destruction as seen in cellulitis and lymphangitis respond unusually well to chemotherapy.

4. The caking effect of sulfathiazole may produce interference with local wound healing.

5. Wound infections present in chronic leg ulcers and burns can be satisfactorily controlled by local chemotherapy.

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During this period (the late Middle Ages) the three pressing medical problems with which Europe had to contend were the care of lepers, the elimination of prostitutes, and the stamping out of the plague. This age succeeded in exterminating leprosy, though by most inhuman means. The plague raged furiously at times and decimated hamlet, city and country; but it had its crisis and abated. Prostitution remained perennial and unsolved. The ravages of venereal diseases from this source, the spread of disorderly conduct, and the moral decreptitude interested medical, secular and ecclesiastical authorities.

ANEURYSMS OF THE CORONARY ARTERIES

REVIEW OF THE LITERATURE AND REPORT OF A CASE

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BOUGON,[1] in 1812, reported the first aneurysm of the coronary artery. During the following 116 years only thirty cases are recorded according to the excellent review of Packard and Wechsler.[2] Snyder and Hunter,[3] in 1934, reviewed three cases of aneurysms of the coronary arteries published in the interval between 1928 and 1934 and added a fourth. Harris,[4] in 1937, reviewed the literature on aneurysmal dilatations of the coronary arteries. This author reports three cases from the literature which are not included in previous reviews and adds one additional case, making a total of thirty-eight recorded to 1937.

Six cases of aneurysms on the coronary arteries which have not been included in the previous reviews have been found in the literature.[5-10] Seven cases have been reported since 1937.[11-17] A grand total of fifty-one cases of aneurysms associated with the coronary arteries, therefore, has been recorded. In some of these reports the authors have used the diagnosis, "coronary aneurysm," very loosely. To illustrate, the case of Schuster[11] is an aneurysm of the sinus of Valsalva, only, with secondary involvement of the coronary artery.

In this paper as in any similar review, it is difficult to classify satisfactorily all the cases since sometimes the data are meager. The reviewers[2,3,4] have usually analyzed and discussed the individual cases of coronary aneurysms included in their papers. Packard and Wechsler[2] include considerable clinical data in their article. They find that (1) the condition is three times as common in males as in females; (2) etiologically, the cases can be divided into two main groups: mycotic-embolic and arteriosclerotic; (3) the mycotic-embolic aneurysms occur in association with an acute or subacute bacterial endocarditis of the aortic valve; (4) the average age is twenty-seven; (5) in the arteriosclerotic group, a marked coronary sclerosis is present; the average age is fifty-seven; (6) syphilitic meso-aortitis occurs in only three cases in their series; (7) trauma plays an insignificant etiologic rôle; (8) there are neither pathognomonic symptoms nor physical signs which make possible an antemortem diagnosis of a coronary aneurysm. Snyder and Hunter's[3] review is concerned primarily with a discussion of aneurysms arising in the sinus of Valsalva associated with syphilis. The case they report is syphilitic. Harris[4] discusses congenital anomalies of the coronary arteries in both man and some of the lower animals.

The following observations of Packard and Wechsler[2] are significant in the study of aneurysms of the coronary arteries: "When the aneurysm is single, it is practically always situated immediately beyond the coronary orifice, within the first inch of its course. The others, including the multiple aneurysms are usually found at the point of division of the artery." Forbus[18] has studied in detail the aneurysms that develop at the point of bifurcation of the medium size cerebral arteries. He concludes that these aneurysms develop in association with defects in the muscular coats which are located at the apex of the acute angle formed by the division of the vessel. Data are meager on the frequency in which this defect occurs in the medium size arteries. It was present in only two

coronary arteries in a group of nine cases, in two mesentery arteries in a group of nine cases and twenty-five times in thirty-

FIG. 1. A, the aneurysms located at the bifurcation of the left coronary artery are shown here. The thrombus in the circumflex branch is in the upper left hand corner of illustration. The infarction of the left ventricle is obvious. Lower insert shows aneurysms on the right coronary artery. The aorta is to the left.

three cases of cerebral arteries.[18] Muscular defects have been seen by Forbus[18] in the arteries of the kidneys and of the pulmonary system. He suggests that the muscular coat at the bifurcation of two vessels fail to fuse completely during embryonic life and that this defect constitutes a "locus minoris resistentiae" in the vessel wall. It is true that aneurysms may arise in the medium size arteries from causes other than congenital defects. It is most likely, however, that any aneurysm occurring either in or near a bifurcation of such a vessel develops as a result of this defect.

CASE REPORT

F. M. was a thirty-three year old colored male. Four days previous to his admission to the hospital he was awakened at 4:00 A.M. by a sudden substernal pain. This pain, during the first twenty-four hours following its onset shifted to the left chest and epigastrium. On admission, the patient complained of pain in
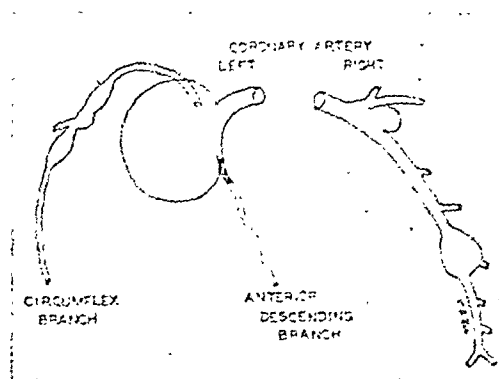
FIG. 2. A diagrammatic sketch of the location of the four aneurysms on the right and left coronary arteries.

the left chest and orthopnea. The temperature was 102°F., the pulse was 120, the respirations were 22 and the blood pressure was 80/60. He was well developed, alert, co-operative, and did not appear acutely ill. The heart was symmetrically enlarged and the sounds were distant. The cardiac rate was rapid but regular. The apex beat was present in the fourth and fifth intercostal spaces and extended 2.0 to 3.0 cm. on either side of the midclavicular line. An electrocardiographic tracing indicated the presence of an occlusion in the left coronary artery. Pulmonary congestion was present in the lower portions of the lungs at the time of his admission to the hospital.

The patient improved following hospitalization. The temperature subsided after approximately four days. On the eleventh hospital day the patient developed an acute respiratory distress. He sat up in bed and gasped for breath. Moist râles rapidly developed throughout his chest. Respiration grew progressively more shallow and he died four hours following the onset of this respiratory distress.

The red blood cell count, the white cell count and the hemoglobin were normal. The Kahn test was negative. The autopsy was performed three hours following death.

The only pathological changes observed in this case were associated with the heart. It weighed 450 Gm. A fibrinous hemorrhagic exudate was present over the epicardium. It was most extensive in the area of the left ventricle. The myocardium in the left ventricle and the greater portion of the interventricular

septum was necrotic. The necrosis occurred in that portion of the cardiac muscle supplied by the anterior descending branch of the left

Fig. 3. These three microphotographs are from the aneurysm on the right coronary artery located proximal to the aorta. The arrows indicate the direction of the flow of the blood. a, the lumen of the small arterial branch is indicated by x. The margin of the aneurysm is located in the acute angle formed by this vessel. The intima is markedly hypertrophied and the muscularis stops at the margin of this aneurysm. b, the wall of the aneurysm is formed primarily by hyaline connective tissue. A thrombus is attached to the intima. c, note the thick intima and the abrupt interruption of the muscularis at the distal margin of the aneurysm. The opposite wall is normal.

coronary artery. Only a few inflammatory cells infiltrated the necrotic myocardium. An extensive fibrosis was present throughout the area of the myocardial necrosis.

An aneurysm 2.0 by 1.5 cm. was present on the left coronary artery at a point 1.5 cm. distal to its orifice. (Figs. 1A and 2.) This aneurysm was located at the point of bifurcation of the anterior descending and circumflex branch. The muscularis of the vessel wall rapidly decreased in width as the wall of the aneurysm was approached. The intima became greatly thickened. The internal and external lamellae gradually decreased in amount as they extended into the wall of the aneurysm. The adventitia was increased in amount. In some areas the wall was formed by hyaline connective tissue which was continuous with the intima on one side and the adventitia on the other. Few round cells infiltrated the adventitia. An atherosclerotic process occurred along the inner surface of this aneurysm.

The orifice of the circumflex branch is shown at the proximal end of the aneurysm inferior to the opening of the left coronary artery. (Fig. 1.) It was grossly normal for a distance of 1.5 cm.

at which point it dilated to a diameter of 1.0 cm. (Fig. 2.) This annular aneurysm extended along the artery for approximately 2.0 cm. A small artery had its origin in this aneurysmal dilatation. The lumen of this latter vessel was partially occluded by a sclerotic plaque.

The anterior descending branch of the left coronary artery originated from the distal part of the aneurysm and extended along the anterior longitudinal sulcus. A recent thrombus occluded this vessel at a point immediately distal to the aneurysm.

The right coronary artery was examined by removing the adjacent fat before the lumen of the vessel was opened. An aneurysm was present on this artery at a point 0.5 cm. distal to the wall of the aorta. This aneurysm was 1.0 cm. in diameter and was located at the apex of the acute angle formed by a large branch leaving the right coronary artery. (Fig. 1B and 2.) A second aneurysm was present on the right coronary 5.0 cm. from the aorta. This annular aneurysmal sac was 1.0 cm. in diameter and involved 2.0 cm. of the lumen of the artery. A small branch left the coronary artery in this aneurysm. (Fig. 2.) Serial sections were made from the two aneurysms on the right coronary artery. Some of the sections were

stained with hematoxylin and eosin while others were stained to demonstrate the elastic tissue.

intima became markedly thickened in the wall of the vessel on both sides of the aneurysm (Fig. 4B.) The muscularis either completely

FIG. 4. The annular aneurysm located on the right coronary artery. A, the wall is formed by hyaline connective tissue and irregular and fragmented portions of muscularis. B, the wall of the coronary artery is markedly distorted at the margin of the annular swelling. The intima is hypertrophied and the muscularis is fragmented.

Histological studies of the aneurysm located at the bifurcation of the vessels on the right coronary showed a marked alteration in the intima, media and adventitia at the point where the sac began. The intima was tremendously thickened. (Fig. 3C.) The wall of the sac was formed primarily by hyaline connective tissue. The internal elastic membrane disappeared at the border of the sac. (Fig. 3A.) The muscular coat likewise almost completely disappeared at the border of the sac, only a small amount being present in the wall. (Fig. 3B.) There was only a moderate amount of adventitia over the wall of the sac. An occasional round cell was present in the wall. A thrombus was present in the lumen of this aneurysm. (Fig. 3B.) The base of this thrombus was organized. The vessel wall opposite to the aneurysmal dilatation was normal except for the presence of a small amount of atherosclerosis. (Fig. 3B.)

The histological changes in the aneurysmal dilatation on the right coronary located distal to that described above were quite different to those previously described. The intima, media, and adventitia were normal until they approached the aneurysmal dilatation. The

stopped or became markedly decreased at the margin of the dilatation. The internal and external lamellae also either stopped here or they became markedly fragmented. The wall of the aneurysm was composed of hyaline connective tissue with areas of calcification. Portions of the fragmented and greatly distorted muscularis were present in some areas of the wall. (Fig. 4A.) There was a moderate amount of adventitia in the wall. Few round cells infiltrated this portion of the aneurysm. As far as we could determine from our examination there were no vessels leaving the aneurysmal dilation at the point where the muscularis was so distorted.

The orifice of each of the coronary arteries was normal. The aortic valve showed only a few sclerotic plaques. There was essentially no atherosclerosis in the aorta. All the valves of the heart were normal. The cavities were moderately dilated. There was congestion of the viscera and a bilateral hydrothorax (right 1,400 cc. and left 900 cc.).

Anatomical diagnosis: multiple aneurysms on the right and left coronary artery (congenital); recent thrombosis of the descending branch of the left coronary artery; acute

myocardial infarction of the left ventricle; acute fibrinous pericarditis; dilatation of the right and left ventricular cavities; chronic passive congestion of viscera; pleural effusion, bilateral (left 900 cc., right 1,400 cc.).

Petechiae in the mucosa of the intestinal tract; a minimum amount of coronary sclerosis; small calcified nodules in the lungs; diverticulae in the colon; fibrosis of the myocardium in the left ventricle (old infarction) and laceration of the skin over right foot.

REMARKS

Two of the four aneurysms occurring on the coronary arteries in this case are located at either the point of bifurcation or at the point where a branch leaves the parent vessel. Defects in the coronary arteries in such locations have been demonstrated by Forbus.[18] We, likewise, have found a similar defect in the left coronary artery in a boy fourteen years of age. (Fig. 5.) Aneurysms occurring at the point of bifurcation of the cerebral vessels have been attributed to a similar defect. It appears likely that two of the aneurysms in our case may have developed on account of a medial defect which may be explained on a congenital basis.

The two aneurysms which occurred as an annular dilatation on the anterior descending branch of the left coronary and on the right coronary arteries apparently represent a different type of development than those occurring at the bifurcation of the coronaries. Only one of these two annular aneurysms were studied histologically. This aneurysm differed from those occurring at the point of bifurcation of the coronary artery in that the intima and the muscularis in the wall of each side of the vessel was distorted. There was some arteriosclerosis in the wall of the artery at the point of this aneurysm. In our opinion one could not say conclusively that this aneurysm developed as a result of the arteriosclerosis. The absence of an inflammatory reaction in the wall of the artery would not be conclusive evidence that this annular aneurysm did not follow an inflammatory process; however, one

could not conclude that it did develop secondarily to an inflammatory reaction. Congenital defects in the wall of arteries

Fig. 5. Point of bifurcation of left coronary artery in a boy fourteen years of age. Observe the failure of fusion of the muscularis of the two vessels at the acute angle. The adventitia and the intima are continuous. The intima is thicker than normal. Congenital defects such as this may be the etiological process in the development of aneurysms.

have been observed by several investigators and their observations have been discussed by Forbus.[18] From this discussion it appears likely that the two annular aneurysms occurring on the right coronary and the anterior descending branch of the left coronary artery may have resulted from a congenital defect in the walls of these vessels.

The frequency in which aneurysms develop at the points of division of the coronary arteries has been emphasized by Pacher and Wechsler.[2] These investigators observed that when aneurysms are single they occur within the first inch of the coronary vessels. The aneurysms described by Vogelsang[19] and Monahor[13] appear to be identical in location with two in our case. Both investigators consider that their case developed on the bases of syphilis.

There is some atherosclerosis in the coronary arteries in our case. There is neither a history nor serological nor

pathological evidence of syphilis in this patient. The histological changes in the coronary vessels and the wall of the aneurysm do not indicate that a previous inflammatory process might have been the bases for the development of these aneurysms.

It is obvious from a review of the literature that aneurysms occurring on the coronary arteries are rare. Many of the reported cases result from embolic and mycotic phenomena.[15,17] Some of the aneurysms apparently developed in association with rheumatic arteritis,[12] while others are associated with arteriosclerosis[6] and syphilis.[3] It is suggested that some of these aneurysms in previous publications may have developed on the bases of a congenital defect in the media of the artery.[13,18]

The infrequency in which a medial defect occurs at the bifurcation of the coronary arteries is indicated by the observations of Forbus.[18] Furthermore, it must be remembered that aneurysms do not always develop when there is present a muscular defect in the cerebral, mesenteric, and coronary arteries. The pathological data at this time apparently justify the conclusion that aneurysms may develop on the coronary arteries either at the point of bifurcation or in the angle formed by a branch leaving the parent vessel as a result of a congenital defect in the development of the media of the arteries. It has been suggested by Forbus[18] that this defect results from the failure of the media to fuse in the wall of the two branches. The wall of the artery, therefore, is potentially weaker at the bifurcation than elsewhere. We are not familiar with the frequency in which congenital defects occur in the wall of arteries at points other than at the bifurcations, however, it would appear that the development of aneurysms in such locations is infrequent.

SUMMARY

The fifty-second case of an aneurysm occurring on the coronary artery is re-

ported. It is suggested that the aneurysms located at the bifurcation of the major branches of the coronary arteries develop as a result of a congenital defect which occurs in the media of the artery.

The cases of aneurysms occurring on the coronary arteries previously reported are briefly reviewed. It appears that some of these may have developed as a result of a defect at the point of bifurcation of the coronary vessels. The location of some of these aneurysms in regard to the aorta and the branches of the coronaries is similar to that in our case.

Etiological agents other than congenital defects may produce aneurysms in the coronary arteries.

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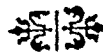
Scattered obstetrical and gynaecological references are found in the text of the uroscopist Gualterus Agulinus and that of Petrus Hispanus, who dealt with amulets and magic formulae and warned against the menstruating woman. Gilbertus Anglicus advocated perineal protection and repair in delivery. Among the causes of prolapse, he included complete perineal laceration. Gilbertus suggested the novel method of using leeches at the vulva in cases of lost virginity to simulate defloration bleeding, adding that the minute scars found at the sucking points would be easily obliterated by the trauma of coitus and bleeding would follow.

SUTURE MATERIALS

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DURING the past few years there has been a vast amount of excellent work done in many laboratories on the subject of wound healing and the type of sutures which will facilitate the best end results. Until about ten years ago, it was generally believed, although there were a few serious students who clung to the use of silk, that catgut was the ideal suture material. When reports of wound disruptions, the frequency of stitch abscesses, wound infections, hematomas, etc., began to fill the literature it became evident that there was ample room for great improvement. Since that time manufacturers, as a result of these disclosures and the pressure it brought upon them, have evolved finer sizes of catgut and incomparably more efficient methods of sterilization. It is, undoubtedly, true that more and better types of all varieties of suture materials are being produced at present than at any time in our history. However, general knowledge of this progress has not penetrated into the surgical consciousness of many of our confreres and no material has yet emerged that fills every need. As a logical consequence, there is good reason for a periodical review of the subject, for a critical examination of widely held views, for discarding notions which have been proved to be fallacious and for an earnest attempt to improve our results by intelligent application of recently acquired information. It is to those surgeons who are not entirely satisfied with their present results that this essay is addressed. As a preliminary to a more detailed discussion of the subject, a brief restatement of certain basic surgical principles might not be out of order.

First, the only purpose of any suture, absorbable or non-absorbable, is to hold tissues in approximation until such time as they are able to reunite.

Second, it is quite obvious that the smallest amount of any material should be used that will safely accomplish this result.

Third, the holding power of tissues for sutures (tissue tension) should always be kept in mind. Roughly speaking, this figure is in the neighborhood of three pounds, which is approximately the tensile strength of o or oo catgut or No. 1 silk. There is seldom any necessity for using larger sizes, as they either cause complications (stitch abscess, allergic reactions, etc.,) or defeat their own intended purposes by cutting through tissues.

Suture materials are divided into two classes: absorbable i.e., catgut, non-absorbable, i.e., silk, nylon, cotton, linen, plastigut, stainless steel wire, equisetene, etc.

The most important varieties of catgut are plain or chromicized. Plain catgut is employed where quick healing takes place and where rapid absorption is desired, for instance in serosa and mucosa covered surfaces, and for the ligation of small blood vessels. Chromic catgut should be selected for approximating fascial and connective layers and for tying the larger blood vessels. The thrombus which immediately forms in a small blood vessel may be depended upon for hemostasis, but in the larger arteries or veins the process of fibroplasia and connective tissue formation is the important factor of safety and it is, therefore, desirable to ligate these structures with catgut which is slowly absorbed.

It should also be pointed out that certain tissues, i.e., skin, subcutaneous fat, muscle and mucous membranes do not tolerate any sort of catgut very well. The skin being

filled with hair follicles and sebaceous glands which almost always contain bacteria is quite prone to infection. The subcutaneous fat has but little holding power and probably should not be sutured unless it is necessary to obliterate "dead spaces," in which event the very finest sizes ooo or oooo should be utilized. Muscles are in much the same category as subcutaneous fat, and when they must be drawn together, it is much better to approximate very carefully their fascial envelopes with interrupted sutures of fine chrome gut. Mucous membranes are likewise very prone to become infected, or to be torn by the larger sizes of sutures, and for this reason the very finest catgut (oooo or ooooo) threaded on small needles will give the quickest and strongest type of union.

All catgut sutures, whether plain or chromic, are foreign bodies and as such excite an inflammatory tissue reaction in order that they may be absorbed. Many interesting studies have shown that the degree of this reaction depends almost entirely upon the amount of catgut used. A No. 2 chromic doubled running suture will cause a great deal more exudation, lymphocytic and leucocytic invasion, and more firbroplastic proliferation than a No. oo interrupted stitch. Literally, millions of cells are destroyed in the process of digestion and absorption and naturally the more catgut with triple knots, etc., inserted into the wound, the more body cells must die in the process of removing the foreign body. That is the prime reason for the reddened, inflamed appearance of wounds sutured with large amounts of catgut. The surgeon should always remember that his gentlest efforts cannot fail to do tremendous damage to millions of delicate living cells and he should develop a technic that will minimize this harmful effect as much as possible. The idea held by a good many individuals that large amounts of suture materials protect against hemorrhage and give greater strength to a recent wound is entirely fallacious as digestion and absorption of excessive amounts of

foreign bodies can only cause considerable exudation, weaken the thread strength of the suture and greatly slow the healing process. The tissues which should be producing fibroblasts preliminary to the laying down of completed connective tissue are kept busy getting rid of the catgut. There is a vast distinction between sewing up a piece of cloth and uniting living, breathing delicate filaments of cells.

In this connection a word about the best manner in which to secure a good strong wound, as repeatedly demonstrated in experimental surgery, might not be amiss. Briefly, fascia or connective tissue layers should be approximated by sutures not larger than No. o or oo chromic or No. 1 silk and interrupted stitches should be placed at right angles to the direction of the fibers of the supporting structures. If stitches are inserted along the grain of the tissues, they are likely to tear out. If sutures larger or stronger than the holding power of the connective tissue layers are used, they will either cause an unnecessary amount of exudative reaction, or tear through and thus defeat their intended purpose. Long experience of a great many surgeons has shown that about 1 cm. (one-third of an inch) is the proper distance between sutures. Many ventral herniae owe their origin to a continuous suture of No. 1 or 2 chromic catgut, perhaps doubled, which lost its thread strength on the third or fourth day postoperatively and permitted the posterior sheath of the rectus to open widely when the patient retched or coughed. The small amount of time saved in employing a continuous stitch rather than interrupted sutures is hardly worth while in the light of the ultimate results achieved.

Non-absorbable sutures are of various sorts, silk, nylon, cotton, equisetene, linen, plastigut, stainless steel, etc. In general, they do not cause as much irritation to the tissues as does catgut and the healing which follows their use is often spoken of as "dry healing" in contrast to the exudative reaction of all catgut which is

popularly termed "wet healing." The ideal material has not yet been developed and those listed above differ among themselves in the degree of tissue irritation produced and in the mechanical features incident to their employment. Cotton was introduced several years ago and is probably an excellent material. Stainless steel wire is becoming popular in some localities. Had either cotton or stainless steel been used originally they might be the choice of most surgeons at the present time, but it so happens that silk was first introduced by Kocher and afterward used in America by Halstedt, so it remains the most important of the non-absorbable materials. Any remarks concerning the use of silk may with perfect propriety be applied to the other very excellent substitutes.

The general surgical principles embodied in the use of suture materials should properly be the same regardless of the type involved. However, there has grown up in the United States two schools of thought on the matter, and two resulting technics which differ in many important details. In general, it may be said that surgeons who employ silk are likely to understand better the newer discoveries in wound healing, or at least to put them into daily practice, and to cultivate a greater respect for tissues than those who use absorbable material. The knowledge that they are inserting into the tissues something which will remain there for years may predispose to caution. At any rate surgeons who employ silk take a little more time to perform operations, use smaller sizes of sutures, smaller instruments, take tiny bites of tissue, are perhaps slightly more careful about hemostasis, employ more interrupted sutures and cut the ends of knots more closely. Issue might be taken with these rather broad statements, but any individual who has observed a great many American surgeons work in different parts of this country will probably agree that, for the most part at least, they are quite true.

Silk has certain inherent advantages.

It can be boiled repeatedly without impairing thread strength to a marked degree and this obviously means better sterilization. The excellent work done in the standardization and sterilization of catgut during the past few years has greatly improved the product but despite all this, the sterility of catgut does not compare in efficiency with that of silk. As mentioned in preceding paragraphs, silk does not produce the intense exudative and proliferative reaction of catgut and as a result the wound closed with this material will regain its strength more rapidly. In general, the silk wound will heal in two or three days less time than the one closed with catgut and will give a better and stronger scar. Owing to a combination of these favorable factors, there will be fewer wound infections or wound disruptions as has been well shown by numerous statistical reviews. From the mechanical standpoint, braided or twisted silk is not so likely to slip at the knot. When economy is considered, and it is a factor of interest to hospital administrators in this period of rising prices, the cost of silk is approximately one-fifth that of catgut.

One drawback to the universal employment of silk has been the lack of uniformity with respect to sizes among the various manufacturers. However, the recent action of the U. S. Pharmacopeia (12 Decennial Revision) in publishing standard nomenclature for size designations, permissible range of size variation and minimum tensile strength standards and correlating such specifications with similar tables previously released for catgut will have a very helpful effect. Up to the present time, surgeons who might occasionally use silk without a thorough knowledge of its tensile strength would unconsciously feel that the silk suture would need to be the same size as the catgut with which they were very familiar and might, for instance, ask for No. 5 silk when C. or No. 1 would better suit their purpose. When they failed to secure the results they had expected, they were inclined to blame

the suture material without carefully examining the other important factors involved.

There are some contraindications to the use of silk: It should not be inserted in any hollow viscus, i.e., the gallbladder, the urinary bladder, or to unite the mucosal layer of the stomach or small bowel. Concretions have formed on suture ends in hollow viscera. In the small bowel when anastomoses have been performed, small erosions and ulcers have been found at the site where the stitch perforated the mucous membrane. In this connection, it should be remembered that silk is not intended to be used as a continuous stitch as it strangulates tissue. A possible exception to this rule is in closure of the peritoneum where a running stitch does not appear to cause trouble. Likewise, it has been considered unwise to rely upon silk in infected wounds although Shambaugh and Dunphy, in 1937, very carefully investigated this problem and found no logical reason for this widely held opinion. In closing external wounds with silk it should be remembered that if the larger sizes are employed and there is any reason to suspect that the operative field is not reasonably free from harmful bacteria there is likelihood that some of the ligatures may slough through the skin at a later date. The small sinus which results is merely a minor annoyance to the patient and the surgeon and always heals as soon as the offending stitch has been extruded.

A practical consideration in the selection of suture material is that most hospitals and most nurses are trained in the use of catgut and quite familiar with its properties while they are not equally informed as to the advantages and disadvantages of the non-absorbable sutures. As a result, a certain amount of education and very careful supervision is required on the part of the surgeon who would employ unfamiliar materials. If he does not take the time and trouble to watch details, the ultimate result may be failure to secure the quick, firm healing he has been lead to expect.

The purpose of this discussion is not to attempt to convert the surgeon who employs catgut to the use of non-absorbable materials but rather to induce him to reconsider his technic in the light of results achieved by users of silk. It has been repeatedly and clearly demonstrated that wound healing can be accelerated and the numbers of infections diminished by use of smaller sizes of catgut, careful hemostasis, interrupted sutures, avoidance of mass ligation of large pieces of tissue, etc. General adoption of these safe and sane surgical principles may enable users of catgut to approximate the excellent results which have long been commonplace to surgeons who use silk.

Many men are too busy in their ordinary tasks and with the heavy responsibilities thrust upon them in everyday life to give much thought to such matters but if a perusal of this article will cause them to review their knowledge of wound healing and thus improve their operative technic, it will give added luster to the honorable profession of which we have the good fortune to be members.
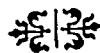
SIGNIFICANCE OF SCHWANNOMAS AS A FACTOR IN OBSCURE CASES OF APPENDICITIS*

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APPARENT discrepances between the clinical and anatomicopathologic findings in appendicitis are only too familiar to both surgeons and pathologists. Not infrequently a vermiform appendix is called normal by the surgical pathologist after a cursory examination of one or two sections fails to disclose infiltration of the wall with exudative cells. Such a practice often proves embarrassing to the surgeon, and is a source of controversy between surgeons and pathologists. In other cases the specimen is described as an "interval appendix" or a "chronic appendix" indicating failure to discover the underlying disorder.

The authors are of the opinion that gross and microscopic study of the removed appendix should include a search for such factors as examination of the contents of the appendix for evidence of catarrhal inflammation and intestinal parasites, e.g., oxyuris vermicularis; anomalies of the valve of Gerlach; interference with the circulation from ptosis, overmobility of the cecum, unusual external pressure; fibrosis with stenosis; foreign bodies, fecoliths; carcinoids and other neoplasms; evidence of peri-appendicitis; evidence of both infection and obstruction, acute kinking by a band or fold; endometrial implantation; mucocele, and the presence of schwannomas often described as neuromas or neurinomas.

The terminations open to inflammation of the appendix are resolution with return to normal; tissue destruction, suppuration, gangrene and rupture; and finally healing with formation of cicatrices. The entire mucosa may be converted to a fibrous mass with obliterations of the lumen. The latter condition is often mistakenly diagnosed as chronic appendicitis. The fallacy of this term lies in the fact that inflammation is a local reaction to an irritant and it, therefore, follows that inflammation is a process and not a state. Fibrosis of the appendix must either be regarded as an atrophic retrogressive process[2] associated with advance in years, or as a result of a previous inflammation and not the indication of an existing inflammatory process. Corelation of pathological findings and the clinical course is of inestimable value in the solution of this controversial question.

Appendiceal fibrosis or obliteration of the lumen is well known to both surgeons and pathologists; however, it was not until the work of Maresch[1] and Masson,[2] in 1921, that neurogenic appendicitis as an entity, was considered. Masson observed that in many adults with history of previous attacks of appendicitis, there was narrowing of the lumen, great diminution or absence of lymph follicles, thickening of the submucosa, hypertrophy of muscle and hyperplasia of the nerves of Neissner's and Auerback's plexuses.

The neuromas arise from the periglandular nerve plexus in the mucous membrane. Argentaffin cells have been demonstrated actually inside the nerve fibers. These cells apparently arise from the epithelium that lines the bottom of the glands of Lieberkuhn by a process of budding and then ingrate into the nerves. The excessive growth in all likelihood is the result of previous inflammation with regeneration of nerves following the process of destruction which probably occurs as the result of an inflammation not severe enough to cause destruction of the appen-

dix. The nerves containing the cells grow and form the neuromas. The specific cells of this tumor are connected in a syncytium like Schwann cells and possess elongated nuclei and are grouped in networks, bundles and palisades. The palisades consist of oval nuclei aligned in the same transverse plane and may be compared in appearance to the staves of a barrel. In keeping with the origin of the cells from the sheath of Schwann the term Schwannoma is preferable to the terms neuroma and neurinoma which suggest tumors made up of nerve cells or perineural fibromas.

Hosoi,[3] in 1933, studied 195 cases of appendicular neuromas based on 344 consecutive vermiform appendices removed at operation showing no gross or microscopic evidence of acute or subacute inflammation. In this series there were 48 per cent with partially or completely obliterated lumen and of these 82 per cent contained axial neuromas proved microscopically. He described 8.2 per cent as having cramp-like and agonizingly severe pain, in 19 per cent acute but not such extreme pain, in 7.7 per cent definite pain but not acute, in 10.3 per cent dull ache in the right lower quadrant, and in 3.1 per cent discomfort in the right lower quadrant or epigastric distress. Fein, Hanan and Seidler,[4] in 1939, listed 202 neuromas among 600 appendices with some degree of obliteration. There was associated acute suppurative appendicitis in 12.1 per cent and subacute appendicitis in eighty-two cases of neuromas of the non-obliterative type. There were 140 or 64.3 per cent neuromatous lesions of the obliterative type which is in agreement with the figures of Hosoi and Masson.

This investigation regarding the significance of Schwannomas of the vermiform appendix is based on a clinical and pathologic study of fourteen cases during the past five years at the Laird Memorial Hospital in which neuromatous lesions were demonstrated in the appendices by histopathological examination.

Age and Sex. Eight patients were females and six males. The ages were fifteen, twenty, twenty-one, twenty-two, twenty-three, twenty-four, twenty-eight, thirty-one, thirty-two, thirty-three, thirty-three, forty-three and forty-four years, respectively. The youngest patient was fifteen and the oldest forty-four years of age. The average age was twenty-seven years.

Character of Pain. Eleven of the patients complained on admission, of intermittent, cramp-like recurrent attacks of sharp, colicky pain in the right lower quadrant. This was often sufficiently severe to cause them to double up. Two complained of generalized abdominal discomfort, and one of posterior lumbar and low abdominal pain.

Nausea and Vomiting. Ten of the group had nausea followed by vomiting. Four complained of neither nausea nor vomiting.

Physical Examination. Two patients were notably apprehensive and had an anxious facies. There was tenderness on palpation over the right lower quadrant in all fourteen cases. One patient had board-like rigidity of the entire abdomen and one had tenderness on palpation over the left lower quadrant as well as the right. Eight had a slight increase in temperature of 1°F. or less. The highest oral temperature recorded in the series was 99.6°F. The pulse rate was over 90 in only three cases, with rates of 96, 96 and 120, respectively. Three also had a respiratory rate of over 24. Recording of the blood pressure disclosed no systolic readings over 150 and but two diastolic measurements over 90.

Clinical Laboratory. Urinalysis, leucocyte count, hemoglobin estimation, Kahn test, and sedimentation rates according to the method of Westergren, were performed in all fourteen cases. In only four patients was the total leucocyte count over 10,000. The highest leucocyte count was 14,000 in the patient who had board-like rigidity of the abdomen. The differential leucocyte count in this case was 87 per cent polymorphonuclears, 2 per cent monocytes and 11 per cent lymphocytes. Differential leucocyte count disclosed four patients

with over 75 per cent polymorphonuclears. One patient had 9 per cent monocytes and another had 4 per cent eosinophiles. The sedimentation rate was increased in five patients. The Kahn precipitation test for syphilis was negative in all cases.

Postoperative Course. The postoperative course was uneventful in thirteen cases. All of these patients were relieved, and follow-up examinations disclosed no complaints or evidence of disease. The woman who had complained on admission of posterior lumbar and low abdominal pain, continued these complaints at subsequent check-up examinations. Thorough physical examination did not disclose an anatomic basis for complaint.

Surgical Pathology. Histopathologic study of the removed appendices utilizing hematoxylin-eosin and Masson's stain, disclosed plexiform and axial neuromatous lesions in all fourteen appendices. In one of the cases an axial neuroma was observed and also infiltration of the subserosa and tunica muscularis with aggregations of small polyblasts and polymorphonuclears.

COMMENT

Neurogenic appendicitis is very difficult and at times impossible to differentiate preoperatively from early obstructive appendicitis. The temperature, pulse and respiration remain normal or only slightly elevated in the case of uncomplicated neuromatous lesions of the appendix. The leucocyte count and sedimentation rates tend to be within normal limits. The acute pain of neurogenic appendicitis tends to be colicky, cramp-like and momentary or intermittent, followed by a dull ache.

SUMMARY

1. The pathological changes of Schwannoma of the vermiform appendix is presented with an evaluation of its significance in neurogenic appendicitis.

2. Fourteen cases are described, of patients complaining of lower right quadrant pain, thirteen of whom were relieved by appendectomy with histopathologic demonstration of axial neuroma or Schwannoma in the fourteen cases.

3. Patients with Schwannomas of the vermiform appendix may have co-existing acute appendicitis and vice versa.

4. Neurogenic appendicitis must be considered in patients complaining of attacks of intermittent, colicky, cramp-like lower right quadrant pain and having normal temperature, pulse and respiratory rates, and with hematological survey within normal limits.

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AN EVALUATION OF THE McNEALY CECOSTOMY*

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IN general, it would seem that the cecum is not the best site for the creation of a permanent colostomy. However, in certain instances the creation of a temporary cecostomy is life saving. The most common indication for such a procedure is in patients with a large bowel obstruction due to a tumor of the distal colon, in whom the intestinal canal cannot be decompressed by any of the usual methods of suction or irrigation.

In many instances there is intra-abdominal contamination at the time of formation of the cecostomy due to fecal spillage in performing the cecostomy. Peritonitis may occur and the mortality is high in such a case.

A large bowel obstruction seems to be less toxic than a small bowel obstruction. A period of ten to twelve hours' delay in opening the cecum is not in itself dangerous to the life of the patient. It would seem then, that the cecostomy advocated by McNealy,[1] in 1937, would fulfill the two obligations demanded in this type of procedure. First, it allows of no intra-abdominal spillage, and secondly, produces a vent for decompression.

The type of cecostomy described in the original article is as follows:

"Under local infiltration the cecum is exposed through a muscle splitting incision similar to that used for appendectomy. The anterior wall of the cecum is drawn gently through the incision and clamped along the anterior tenia with one or two curved forceps. No sutures are used anywhere in the operation. Between the serosa of the cecum and the anterior parietal peritoneum a strip of iodoform gauze is inserted to facilitate the formation of protective adhesions . . . in the usual cases the incision is packed open down to the peritoneum, and left undisturbed for twelve hours. A catheter may then be inserted."

It will be seen that there is no possibility of leakage into the abdomen in this method, because there are no sutures taken, and because the cecum is not opened in the free peritoneal cavity. The usual type of cecostomies, using the purse-string method of Stamm, or the buried tube method of Witzel, always allow contamination into the general peritoneal cavity no matter how carefully one packs off the field. Also, it is impossible to take "seromuscular" sutures in a thin distended, edematous cecum. Some must go into the lumen and allow further leakage.

There is no doubt that a cecostomy is a poor permanent type of colostomy. The contents of the right colon are liquid, the entire bowel current is not diverted, and the cecostomy will close if the distal obstruction is relieved. However, these very points make a cecostomy an ideal temporary vent for the relief of distal colon obstruction. The liquid contents tend to drain easily, the cecostomy will close spontaneously after the distal colon is either resected, or a permanent colostomy performed.

I have used this type of cecostomy eighteen times in the past year, to provide decompression in cases of large bowel acute mechanical obstruction, due to blockage of the distal colon. In all of these cases the distention was very marked, and was unrelieved by the usual intestinal suction and irrigation. Some of the patients were markedly obese. I have followed these cases throughout the course of the secondary procedures, or through postmortem

examination if death occurred. In none of these cases was there any intra-abdominal contamination around the cecum, as evidenced by any form of peritonitis. Any leakage into the abdomen from the cecum in this type of a case usually will result in peritonitis and death. A procedure which markedly reduces this possibility is of value. From the evaluation of the cases cited above, I believe that the McNealy cecostomy completely obviates such a possibility.

There are a few added points which tend to make this a simple procedure, and attention to them will result in the formation of a safe and efficient temporary decompression vent.

The exact position of the cecum should be known before operation. This can be done by means of a flat film of the abdomen. The cecum is high in many instances, and because of mesenteric fixation, distends laterally rather than anteriorly. This has been pointed out by Hendricks.[2]

Because of this possibility it is well to make a rather high incision, about two inches higher than the usual McBurney incision.

It is well to defer placing the forceps on the anterior tenia of the cecum until after the iodoform gauze has been inserted between the parietal peritoneum and the cecum. If the cecum should tear at this point the iodoform would tend to protect contamination. I have never seen the cecum tear in placing these forceps, but in late cases it might be so very friable as to tear.

The handles of the forceps should be taped flat against the abdominal wall by the surgeon. Only he knows exactly how much tension has been necessary to pull the cecum out, and further tension in application of the tape to the forcep handles might result in tearing the structures.

At least six hours should be allowed to elapse before the cecum is opened.

McNealy advocates twelve hours. The longer that one allows agglutination to occur, the less is the possibility of subsequent leakage.

In opening the cecum, it is well to insert a braided silk purse-string and a Pezzar catheter. However, in very obese persons so little cecum is delivered, that this is impossible. In these patients, simple opening is sufficient, although somewhat more messy to care for, than if a tube is used.

The curved forceps should not be removed. They will slough through and fall off of their own accord in about ten days. This will increase the available stoma and make the cecostomy function better.

SUMMARY

1. In the event of mechanical obstruction of the distal colon, the establishment of a temporary cecostomy may be used in case the conservative measures fail to decompress the intestinal canal.

2. In establishing such a cecostomy, the spillage of intestinal contents from the cecum into the general abdominal cavity is a serious problem and carries an increased mortality.

3. The McNealy type cecostomy establishes a vent proximal to the obstruction with no possibility of spillage at the time of such a procedure.

4. In a series of eighteen cases of large bowel obstruction, unrelieved by irrigation or suction, this type of cecostomy was utilized by the author.

5. In none of these cases was there any spillage into the abdominal cavity.

6. Several points which simplify the procedure are presented.

7. A cecostomy does not contraindicate nor make more difficult subsequent exploration of the left colon.

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INTRAVENOUS USE OF MORPHINE SULFATE

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ALTHOUGH morphine sulfate has been used therapeutically for about 140 years, too little attention has been given to the use of this valuable and time tested drug by the intravenous route. The feasibility of this method of administration was brought first to my attention in 1933 by a morphine addict who injected the drug into his veins or "shot the main line," as he expressed it in the jargon of his kind.

The intravenous route of administration is especially recommended for patients suffering severe pain because of the rapidity with which the analgesia is produced. I have used intravenous morphine to advantage and with no untoward effects in patients suffering from burns, fractures, biliary colics, renal colics, coronary thromboses, and cardiac decompensations. It is ideal for sensitive patients who are to be cystoscoped, bronchoscoped or gastroscoped. It is a very useful adjunct to regional or local anesthesia. One-sixth gr. (10 mg.) of morphine sulfate given intravenously will often produce sufficient analgesia to enable the surgeon to complete an operation on a patient, in whom the spinal anesthesia is beginning to wear off, without supplementary anesthesia.

Tuohy[2] states that usually an opiate is administered to patients as part of their preoperative medication, but that not infrequently the sedative effect is insufficient. In these cases the addition of ⅛ to ⅙ gr. (8 to 10 mg.) of morphine injected intravenously will frequently allay the patient's fears before intravenous anesthesia with pentothal sodium and materially decrease the amount of the anesthetic which must be administered.

In general, the administration of morphine to small children is best avoided because of the instability of their respiratory centers.

The rapidity with which analgesia is produced by subcutaneous morphine varies with the individual patient and the severity of the pain. I have found the length of time necessary to produce analgesia by the subcutaneous injection of morphine to vary from fifteen to thirty minutes. Another disadvantage is the fact that when morphine is given hypodermically, one must wait at least a half hour before determining if a further dose is necessary and then guess as to the size of the second dose.

Morphine sulfate given subcutaneously disappears from the blood stream in demonstrable amounts within twenty minutes after its appearance in it. Traces only remain in the blood stream of a cat two to ten minutes after intravenous administration. However, in dogs the drug remains thirty minutes in the blood stream after its intravenous injection.[3] Morphine sulfate is taken up by the tissues from the blood and gradually destroyed or eliminated. A variable proportion of the drug (about ⅕) is excreted in the urine, part free and part conjugated, while a much smaller amount is accounted for in the feces and other secretions of the body. The greater part is destroyed in the tissues, chiefly by the liver.

The effect of the drug after intravenous administration, in spite of being more pronounced at first, probably will last almost as long as the effect after subcutaneous administration.[4]

Varying sensations are described by patients who have received morphine sulfate intravenously. A few experience mild dizziness, tinnitus, tachycardia, and a feeling of warmth. Fainting with a quick recovery rarely occurs. Nausea and vomit-

ing are much less frequent following intravenous injection than following subcutaneous administration, probably because the vomiting center is depressed more rapidly by the intravenous use of morphine.[1]

A safe and simple method for the intravenous administration of morphine sulfate is as follows: Ampules of a sterile solution of morphine sulfate are preferable, but the tablet form may be used if ampules are not available. A 1 cc. ampule containing 1/6 or 1/4 grain (10 or 15 mg.) of morphine sulfate is aspirated into a 2 cc. syringe. A No. 20 gauge intravenous needle is attached. After venipuncture 1 cc. of blood is drawn into the syringe, and the syringe rotated gently to facilitate an even distribution of the blood in the solution. Three tenths of a cc. (.3 cc.) of the resulting solution is administered and one-half minute allowed to elapse. Any idiosyncrasy to the drug will be noted by that time if it is going to appear. The solution is then injected slowly (roughly, .2 cc. every five seconds) until the desired effect is obtained. No more of the drug should be injected than the amount necessary to obtain the result one wants. After complete relief of pain is obtained a small dose, 1/8 gr. (8 mg.), may be given hypodermically, if needed, to maintain the effect. Naturally, more of the drug will be required by patients in the throes of agonizing pain. However, it is not considered safe to give more than 1/4 gr. (15 mg.) of morphine

intravenously at any one time. Should relief of the pain not be brought about by the first injection, it is safe, after an interval of ten minutes, to give a further injection, 1/8 to 1/6 gr. (8 to 10 mg.), slowly until relief is experienced.

In cases in which the dose of intravenous morphine cannot be gauged by the relief of pain, the patient is asked to notify the physician if such symptoms as dizziness, weakness, drowsiness, warmth, numbness, tingling, neuralgic pain, or backache occur. If one of these symptoms occurs, the injection is stopped. As a rule, 1/8 to 1/6 gr. (8 to 10 mg.) of morphine sulfate may be given intravenously to an adult without fear of an untoward reaction.

SUMMARY

The intravenous use of morphine sulfate is advocated in certain cases because the desired full analgesic effect is obtained immediately from an accurately regulated and individualized dose of the drug.

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Case Reports

PRIMARY SARCOMA OF DUODENUM

RESECTION WITH HEAD OF PANCREAS BY ONE-STAGE WHIPPLE OPERATION

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PRIMARY neoplasms of the small bowel are infrequent, malignant ones comparatively rare and sarcomas of the duodenum very rare. In a series of 17,000 autopsied cases at Guy's Hospital, Brill found ten primary malignant tumors of the small intestine; four were carcinomas and six sarcomas. Only one of the sarcomas arose from the duodenum. Raiford found not a single case of sarcoma of the duodenum in 986 cases of neoplasms of the gastrointestinal tract. In his series there were eighty-eight tumors of the small intestine of which fifty were benign and thirty-eight malignant and only two were sarcomas. Of the eighty-eight tumors, twenty-one involved the duodenum, and of these seven were malignant, all carcinomas.

From a series of 1,456 postmortem examinations and 41,000 surgical specimens Medinger collected twenty-two primary malignant tumors of the small bowel; eight were sarcomas.

Feldman collected fifty-eight cases of sarcoma of the small intestine from 104,621 necropsy reports and of these two were located in the duodenum.

All proved primary sarcomas of the duodenum reported in the literature previous to 1935 were collected by Prey, Foster and Dennis. They were able to assemble only sixty-one authentic cases and reported one of their own. They found several additional cases which probably belonged in the series but which could not be included because the reports were indefinite in respect to the location or primary nature of the tumors. Their report revealed a large predominence of lymphosarcomas. There was essentially an equal numerical distribution of the other cell types, spindle cell or fibrosarcomas, myosarcomas, melanosarcomas and myxosarcomas. Although these tumors frequently attain considerable size, they do not as a rule cause obstruction of either the duodenum or common bile duct. They usually cause much pain, anorrhexia and a rapid loss of weight and strength. Necrosis within the tumor is common and not infrequently this results in hemorrhage or in perforation of the wall of the duodenum with fistula formation.

The occasional relatively benign myosarcoma can often be excised without sacrificing the duodenum. The other types of sarcomas are usually too diffusely disseminated for surgical extirpation. On a rare occasion, however, there may be sufficient circumscription of the tumor to warrant radical excision of the duodenum. This is also true of the still rarer inflammatory granulomas of the duodenum. What appeared to be an indication of this kind led to resection of the duodenum in the case which we are reporting. This patient was explored with the erroneous pre-

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operative diagnosis of cholecystoduodenal or choledochoduodenal fistula. Finding the wall of the first and second portions of the tion of chronic inflammation and because the pathological process appeared to be confined entirely to the duodenum, the

FIG. 1. A, deformity of duodenal cap with probable filling defects in first and second portions and dilatation of the second portion of duodenum. B, shadows interpreted as barium filled common bile duct and gallbladder. C, barium filling of common duct persists but shadow interpreted as gallbladder has disappeared. It was probably a configuration of duodenum resembling the gallbladder. D, in the six-hour film the common duct is still filled with barium.

duodenum much thickened by what appeared to be either inflammatory or neoplastic infiltration, a biopsy was taken and examined immediately in frozen section. Because the pathologist made a provisional diagnosis from this examina- first and second portions of the duodenum and the adjacent portion of the head of the pancreas were excised. The operation was performed in one stage; otherwise it was essentially the operation described by Whipple, Parsons and Mullins in 1935.

Not until the permanent sections of the tissue had been studied was a final and correct diagnosis of lymphosarcoma made. Although the result in this case, freedom from symptoms for only two months and death from recurrence in three months does not commend this method of treatment, it seemed advisable to report this case for two reasons. As yet there are on record relatively few reports of cases in which the duodenum has been resected. A recent compilation published by Hunt shows a rapid progressive increase in the application of the operation and progress in its technical betterment. In all except our case, so far as we are able to ascertain, the operation has been performed for carcinoma involving the duodenum, pancreas or common bile duct. It is probable that the indications for the operation will be expanded to include not only the very rare resectable sarcomatous and inflammatory lesions but possibly on a rare occasion some lesion such as a duodenal fistula associated with a much mutilated duodenum.

CASE REPORT

University Hospital No. 71517. A housewife of forty-two had always been well until the onset of diarrhea and pain in the dorsal region of the back in August, 1940 (nine months prior to admission). Although these symptoms disappeared after ten days the patient never regained a sense of well being and was never entirely free of pain in the back. Four months later and following a few days of nausea she developed diarrhea and jaundice. Although both cleared within a week, a diagnosis of catarrhal jaundice was made. From that time on she continued to have pain in the epigastrium, increasing pain in the back, occasional attacks of vomiting and progressive loss of strength and weight. The jaundice, however, never recurred.

In March, 1941 (seven months after onset) an exploratory laparotomy was done. The surgeon stated that the pylorus, duodenum and pancreas appeared to be involved in an inflammatory process, which ·he interpreted upon the basis of a localized perforation of a peptic ulcer. Because the gallbladder was distended a cholecystotomy was done. The tube was removed after ten days and drainage of bile promptly stopped.

No relief of symptoms followed the operation.
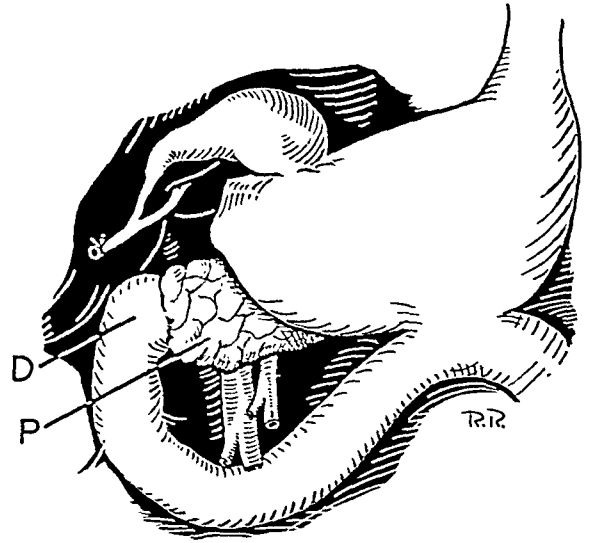
Fig. 2. Operation performed in this case. The closed duodenal stump, D, was sutured to the inverted stump of the pancreas, P, in prospect that the digestive action of the pancreatic juice would spontaneously establish an anastomosis which it presumably did.

An ulcer régime was instituted and this gave no relief.

One week prior to admission (May 15, 1941) the patient experienced a sudden feeling of faintness and weakness. This was followed by comparative relief of pain in the right upper quadrant and epigastrium and by fever. During her illness she had lost forty pounds.

Aside from certain irrelevant findings the physical examination revealed moderate pallor, evidence of recent loss of weight, a recently healed scar in the right hypochondrium and marked tenderness in the epigastrium and right hypochondrium. No masses were palpated. Laboratory studies were: hemoglobin 75 per cent, red blood cells 4,000,000, white blood cells 7,800 with a normal differential; urine negative; icteric index 2; hematocrit normal; normal gastric acidity; 50 per cent phenosulfathalein elimination; Mosenthal normal; stools (4) consistently positive for occult blood, and the prothrombin time was normal.

Radiographic studies showed the barium enema to be negative; the gallbladder was not visualized by cholecystography and the renal shadows were normal with good definition of ilipsoas lines. The esophagus and stomach appeared to be normal, a deformed duodenal cap communicated superiorly with a barium

filled pouch approximately 6 cm. long which was probably gallbladder; the common duct was also visualized; there was hypomotility

FIG. 3. The patient twenty-one days after operation showing healed operative and stab drainage wounds.

and dilatation throughout the second portion of the duodenum. Impression: cholecystoduodenal fistula. Clinical diagnosis: cholecystoduodenal or choledochoduodenal fistula.

Operation was performed after three days of preoperative preparation consisting of 1,000 cc. of whole blood and the daily parenteral administration of 100 Gm. of glucose in addition to a fair caloric intake. Large doses of thiamine chloride and civitimic acid were given by mouth. Out of a mass of tissue bound together by fresh adhesion the gallbladder, common bile duct and duodenum were dissected and no fistulous communication between these structures was found. The gallbladder was not grossly abnormal in appearance. The common duct was moderately dilated. The duodenum was obviously grossly abnormal. The first and second portions were much enlarged circumferentially and the wall felt very thick and had a deep reddish plum color. There were two large glands in the gastrohepatic omentum. The pancreas was normal to palpation and the general abdominal exploration revealed no other abnormality. The duodenum was opened in the search

for further information to aid in establishing a diagnosis. On the posterior and superior surfaces of both the first and second portions there was a large ulcer surrounded by a rolled border of firm thickened mucosa involving most of the remainder of the wall. Within the ulcer was the patulous opening of the common bile duct which measured about 8 mm. in diameter. Through this opening barium could readily pass up the common duct from the duodenum thus explaining the x-ray findings interpreted erroneously as a choledochoduodenal fistula.

A biopsy was taken from the border of the ulcer for diagnostic study in frozen section. It was the opinion of the pathologist that the tissue showed only chronic inflammation. It was decided, therefore, that resection of the duodenum was feasible and indicated. The stomach was divided 2 cm. proximal to the pyloric sphincter and the duodenum down to 4 or 5 cm. proximal to the legamentum Trietz was excised with the adjacent portion of the head of the pancreas. The severed common duct was ligated and the stumps of duodenum and pylorus were closed. The severed end of the pancreas was infolded and sutured to the invaginated end of the duodenal stump in the hope that the pancreatic duct would establish communication with the small bowel through the duodenal stump as a result of the digestive action of the pancreatic secretions.

Physiological continuity was re-established by anastomosing the gallbladder to the anterior wall of the stomach and the jejunum to the posterior wall. Sulfanilamide powder was applied to all surfaces in the field of operation. The operation was performed in one stage.

On the third day after operation a pancreatic fistula developed. It closed spontaneously on the twelfth day. Except for this complication the convalescence was uneventful.

During the third week after operation a course of x-ray therapy was given.

At the time of dismissal from the hospital (twenty-six days after operation), the patient was free of symptoms and felt quite well. She remained well for two months and after a month of recurrent pain and anorrhexia she died. Postmortem examination was not made.

The pathologist's report of the specimen follows: The specimen consists of first and second portions of duodenum with attached

pancreatic tissue. The common bile duct can be identified and shows dilatation to about 1½ cm. in diameter. The mucosal surface of the duodenum shows marked and extensive ulceration with a ragged, rolled margin and a thickening of the mucosa extending back 1 to 2 cm. from the margin of the ulcer. This area of ulceration involves the ampulla of Vater which cannot be specifically identified around the patulous dilated terminus of the common duct. Several sections represent the wall of the duodenum and pancreas. Those taken in the ulcerated area show loss of surface epithelium with a surface composed of necrotic granulation tissue with many dilated blood vessels. The margin of the ulcer shows duodenal glands which are quite well preserved. The wall of the duodenum is very extensively infiltrated by an unorganized mass of cells. These are supported by fine strands of connective tissue and many small thin-walled blood vessels. Extensive areas of necrosis are present. The individual cells in preserved areas are comparatively large and show marked variation in size and shape. The nuclei are large and vesicular with a prominent nucleolus and fine strands of chromatin material frequently accentuated toward the nuclear membrane. Multinucleated cells are occasionally seen. Mitotic figures are numerous. The cytoplasm is rather scanty and rather cloudy in appearance without definite granularity. These cells are invading the pancreas and compressing the pancreas, but this extension is quite limited. This is interpreted as a lymphosarcoma involving duodenal wall primarily.

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MALIGNANT HEPATOMA

CASE REPORT

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WE believe it worth while to report this case of malignant hepatoma because of the infrequent occurrence of primary carcinoma of the liver.

CASE REPORT

The patient had an uneventful medical history as a child and as an adult up to the age of forty-six. At that time he began to have periods of pain in the epigastrium. The pain occurred one and one-half hours after meals and was relieved by milk of magnesia. There was pyrosis and vomiting on only one occasion.

On January 2, 1927, the patient was operated upon at Prospect Heights Hospital. The hospital record is as follows:

A male, aged fifty-two, complained of epigastric pain with a history of vomiting on one occasion.

Laboratory data were as follows: Hemoglobin 82 per cent, red blood count 4,100,000, white blood count 7,800, polymorphonuclears 75 per cent, small monocytes 20 per cent, large monocytes 2 per cent, color index 1.0.

A large ulcer the size of a quarter with a deep crater was found upon the posterior wall of the stomach near the greater curvature about 5 cm. from the pyloric ring. The induration extended over an area about the size of a silver dollar. A few glands were present in the gastrocolic mesentery.

A posterior no-loop gastrojejunostomy was performed. This procedure was decided upon because of the patient's loss of strength and weight and the size of the ulcer.

The patient was well until March, 1941, a period of fourteen years, when he was admitted to Kings County Hospital and his case diagnosed as diverticulitis of the rectosigmoid colon and also gastric ulcer. On April 27, 1941, it was decided that there was no evidence of any intrinsic lesion of the stomach or duodenum and the patient was discharged.

On July 31, 1942, the patient was admitted to the Brooklyn Cancer Institute with a diagnosis of carcinoma of the stomach. The hospital records are as follows:

From March, 1942, to the date of admission, July 31, 1942, the patient complained of a constant pain in the gastric region. In March he had a gastric hemorrhage. He stated that he had lost twenty pounds in the three months preceding his admission. In August a mass about 10 cm. in size was felt beneath the left rectus muscle. The same moved with respiration. The patient was suffering with partial intestinal obstruction at the time of admission. In September, he complained of severe cramplike abdominal pains. The entire abdomen was moderately distended and tympanitic. The patient was unable to take fluids by mouth and vomited a yellowish fluid.

Laboratory findings were as follows: August 7, hemoglobin 41 per cent, red blood count 3,800,000, white blood count 6,450, polymorphonuclears 69 per cent, monocytes 8 per cent; August 31st, hemoglobin 46 per cent, red blood count 3,670,000; September 9th hemoglobin 53 per cent, red blood count 3,850,000, white blood count 6,500, polymorphonuclears 72 per cent, monocytes 2 per cent; September 30th, hemoglobin 64 per cent.

On August 10th, the urea nitrogen was 13, creatinine 1.2; sugar 130, sodium chloride 520, total serum proteins 5.8 mg. per cent. The gastric analyses on that same day revealed total acids 8 in the fasting specimen; free acids 0; bile 0; blood positive; lactic acid negative.

No abnormal intrinsic pathological disorder in the stomach or duodenum was seen by x-ray on August 6, 1942. The lesser curvature of the stomach was thought to be compressed by a contiguous structure, most likely the left lobe of the liver. A loop of the intestine which was thought to be the gastroenterostomy was found in close proximity to the pylorus on the greater curvature. However, barium left the stomach via the pylorus and the

duodenum. There was a soft tissue density in the midabdomen and a few isolated loops of small intestine in the left lower quadrant of the abdomen, which were dilated and contained fluid levels.

Six hours after the administration of barium by mouth there was a rather marked distention of these loops with gas and barium. At the end of twenty-four hours much of the barium was still retained in this localized gut dilatation. The contour of the transverse colon, while grossly intact, contained several mucosal irregularities and it was planned to study this area again when the patient's condition permitted. Examination of the abdomen forty-eight hours after the administration of barium by mouth revealed a small amount of barium scattered throughout the entire colon.

From the above x-ray findings it was concluded that there was a partial mechanical obstruction of several loops of the small bowel in the left lower quadrant, a large tissue density in the mid central abdomen, and mucosal irregularity of the transverse colon.

A later study of the formerly suspicious area of mucosal irregularity in the transverse colon showed the irregularity to be much less marked than on previous examination. The irregularity was thought to be due to an extrinsic cause, such as a small amount of ascites or contiguous pressure. The localized area of small gut dilatation in the left lower quadrant was still present but less marked than on the previous examination.

A flat plate of the abdomen on September 2nd was made with vertical rays at the bedside and revealed a moderate gas accumulation in the colon and small intestine. At that time definite evidence of intestinal obstruction was not detected, but it was suggested that an interval study be made to determine whether the gas accumulations were increasing. A rectal examination was negative.

The patient was relieved of his vomiting by the passage of a Levine tube. Six blood transfusions of 500 cc. each of citrated blood were given between August 20th and October 8, 1942. In spite of the treatment, the patient grew steadily worse and expired on October 14, 1942.

Permission was received for postmortem examination and the gross and microscopic findings of the pathologist, Dr. James A. Mitchell, are as follows:

The body is that of an adult white male, appearing to be seventy years of age, 5 ft. 6 in. tall, weighing approximately 100 pounds. An old operative scar is present in the upper right rectus. Edema of the feet and ankles is noted.

A midsection of the body was made and the sternum removed.

The peritoneal cavity contained about 2,000 cc. of clear straw-colored fluid. Many adhesions of the omentum in the region of the gallbladder and the duodenal portion of the intestine are noted.

The pleural cavities each contain about 300 cc. of a straw-colored fluid.

The lungs are bound down to the parietal chest wall by many fibrous adhesions. The lungs on section are reddish-grey in color; both lower lobes are dark red in color and frothy bloody fluid is expressed from the bronchioles on pressure. There is no gross evidence of consolidation.

The pericardium shows no free fluid or adhesions. The heart is normal in size; the myocardium is of a pale red color. On section the valves show no evidence of thickening or vegetation. The aorta is smooth and glistening. The coronaries are patent.

There is noted a gastroenterostomy the opening of which is patent. The stomach mucosa is smooth and shows no evidence of ulcer or tumor. The pylorus is patent and the pyloric region and duodenum show no evidence of neoplasm. The remainder of the gastrointestinal tract shows no change of note. The pancreas is normal in size and on section is light yellowish in color, moderately firm in consistency. The spleen is of normal size; the surface is slate blue. On section the coat is dark red and firm and the trabeculae are prominent.

The liver is enlarged and weighs 2,400 Gm. In the right lobe there is a large nodular tumor projecting above the surface of the liver and on section is about the size of a grapefruit (about 10 cm. in diameter). It is light yellowish in color, rather soft in consistency and shows scattered areas of degeneration and hemorrhage. It is sharply circumscribed from the surrounding liver tissue. In the left lobe of the liver there is also noted another mass projecting above the surface of the liver, which on section is about the size of a small orange (about 5 cm. in diameter). It has a similar appearance and is sharply circumscribed.

The gallbladder is distended and the common duct is dilated, apparently owing to partial

obstruction of the duct by a number of glands. There is no evidence of any stones within the bile ducts. The portal vein is also surrounded by

Microscopically, there is cloudy swelling of the myocardium. The aorta is normal. There is congestion, atelectasis, and anthra-
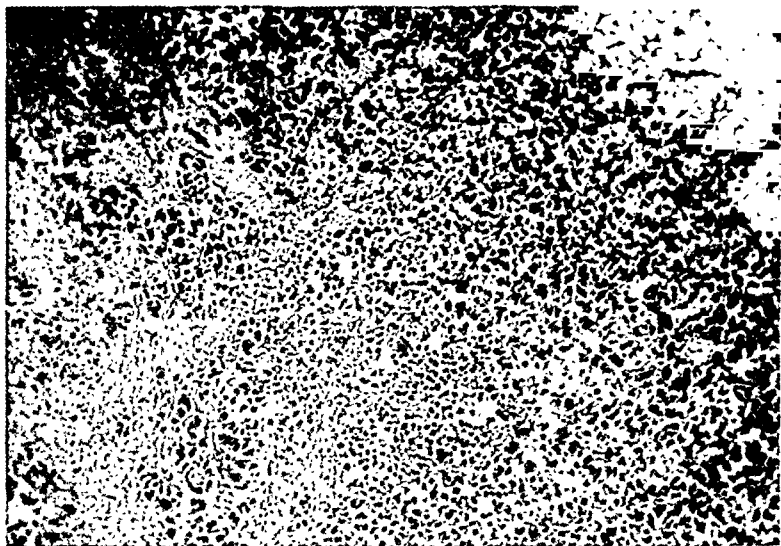
FIG. 1. Low power microphotograph showing a diffuse growth of polyhedral shaped cells.
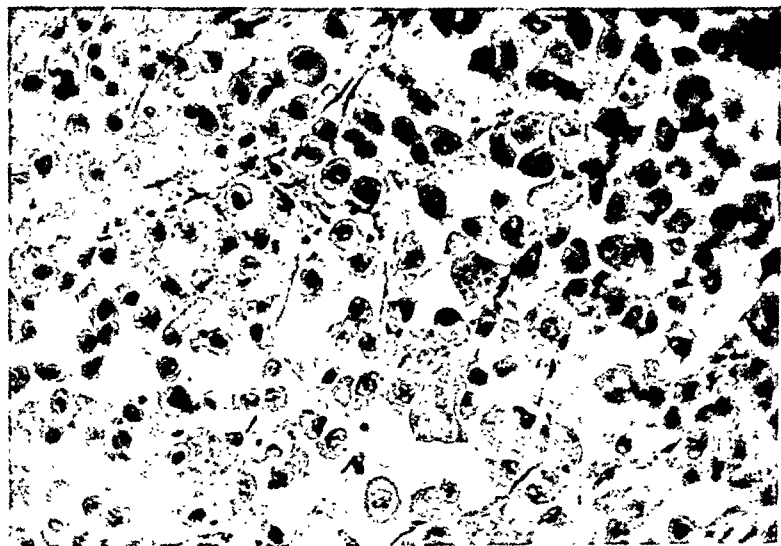
FIG. 2. High power microphotograph showing cells resembling liver cord cells, giant cells and mitotic figures.

a number of glands. The ampulla of Vater is patent.

The kidneys are normal in size. The capsules strip easily, leaving smooth surfaces. The cut surfaces are dark red in color. The cortices are normal in size and the markings are distinct. The ureters and the urinary bladder show no gross pathological disturbance. The prostate is normal in size and on section is light greyish in color and shows a few small circumscribed adenomatous areas.

cosis of the lungs. Sections from the stomach show some atrophy of the mucosa and moderate thickening of the muscular coat. No evidence of ulceration is noted. The pancreas is normal. The spleen shows some congestion and interstitial fibrosis.

Section of the tumor from the liver shows the presence of a neoplasm which is composed of a diffuse growth of large polyhedral shaped cells with pale pink acidophilic cytoplasm and ovoid-shaped nuclei. The cells have no

definite organoid arrangement and running between them is a septa of fibrous connective tissue. The cells resemble very large liver cord cells. Many giant cells are noted throughout the tumor and many mitotic figures are observed. Areas of degeneration and hemorrhage are also noted. (Figs. 1 and 2.)

The mesenteric lymph node upon section shows no evidence of metastatic tumor. The kidneys show some thickening of the coats of the vessels but the glomeruli appear normal in architecture. The prostate shows some hyperplasia in the glands and some cystic dilatation of the glandular structures. No histologic evidence of tumor is noted.

Anatomical Diagnosis: Congestion and edema of the lungs; cloudy swelling of the myocardium; congestion of the spleen; chronic interstitial nephritis; neoplasm of the liver, hepatoma and ascites. The cause of death was malignant hepatoma.

SUMMARY

A case of a sixty-eight year old white male with a history of illness from March, 1941, until his death on October 14, 1942, with no definite diagnosis is given.

CONCLUSIONS

A diagnosis of primary carcinoma of the liver is difficult to make either clinically or with the aid of x-ray or laboratory findings. We can add nothing that might aid in making a diagnosis, but wish to call attention to Ewing's statement that "In this group (multiple liver-cell carcinoma or hepatoma) are included the highly malignant, rapidly growing tumors occurring in livers in which cirrhosis is either absent or so slight as to be of secondary importance. The peculiar clinical course, gross appearance of the liver and the microscopical structure which is often atypical, justify the separate consideration of these cases. There is, however, no sharp division between this group and solitary massive carcinoma, on the one hand and multiple carcinoma following cirrhosis on the other."[1]

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MANAGEMENT OF GASTROJEJUNOCOLIC FISTULA*

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ALTHOUGH gastrojejunocolic fistula today is no longer a rare entity, it still presents one of the most formidable of surgical problems. As recently as 1925, Verbrugge[6] was able to find in the literature only ninety-five cases of gastrojejunocolic fistula resulting from gastrojejunal ulcer while he recorded 121 cases of gastrocolic fistula secondary to malignancy of the stomach or colon. Owing to earlier diagnosis and treatment the malignant type of fistula is now rarely seen, whereas the type secondary to peptic ulcer of the jejunum is relatively much more common. Bornstein and Weinshel[2] collected reports of 322 cases in their review of May, 1941, an addition of 227 to Verbrugge's original ninety-five in a little over fifteen years.

The presence of gastrojejunocolic fistula may be suspected in any patient, especially a male, who presents the picture of diarrhea, foul belching, anemia, and progressive emaciation anywhere from a few weeks to several years after a gastroenterostomy for peptic ulcer. Pain or burning, frequently severe in jejunal ulcer, generally disappears with the formation of a fistula. The clinical picture may resemble pellagra or non-tropical sprue. The diagnosis may be established by roentgenogram or by demonstrating the gastrocolic short circuit by a color enema or one containing readily recognizable particulate matter such as lamp black. In the roentgenographic demonstration of the fistulous tract a barium enema is preferable to an upper gastrointestinal series since a fistula may often not be apparent when barium studies are made of the stomach and small intestine. Missed diagnoses are unlikely if the barium mass is watched under the fluoroscope as it passes up through the large bowel.

Obviously the first consideration in the treatment of gastrojejunocolic fistula concerns the prevention of this complication. Every fistula of this type represents a gastrojejunal ulcer and almost every instance of the latter represents a patient who should not have had a gastroenterostomy. It is unfortunate that there is so much disagreement in the literature with regard to the end results of gastrojejunal anastomosis for peptic ulcer. However, even the most enthusiastic advocates of this procedure now agree that it should be avoided in males in whom ulcer is associated with high acid values. Walters[7] deduces from the extremely low incidence of jejunal ulcer in women that, "gastroenterostomy is a safe and usually a satisfactory procedure for the treatment of duodenal ulcer in the female." In view of the higher mortality of the gastric resection in elderly ulcer patients, some surgeons still prefer gastrojejunostomy for this group, especially when the acid values are low. While Walters and his colleagues,[3] of the Mayo Clinic, still retain this belief, it is interesting to note that in their recent series of fifty gastrojejunocolic fistulas, fifteen of the patients (30 per cent) were over fifty years of age. Hence it would seem that gastrojejunal anastomosis may not be any more satisfactory in the older age group than in young patients. Certainly the most important step in the prevention of this type of fistula is a marked limitation in the previous overenthusiastic use of gastroenterostomy for duodenal ulcer. Moreover, when the latter procedure is performed, it should not be accompanied by pyloric exclusion. Lahey[4] has pointed out that surgical exclusion of duodenal contents from the stomach predisposes to ulcer around the anastomosis.

Apparently even partial gastrectomy fails to guarantee an ulcer cure. Lahey reports five jejunal ulcers in 200 patients with subtotal resection of the stomach. Thus adequate prevention of gastrojejunocolic fistula involves not only careful selection of operative procedure but also the realization that the operation is only part of the treatment, not in itself the complete cure. Long careful follow-up with dietary regulation and the usual hygienic precautions of medical therapy for ulcer are a necessary sequel to operation. Jejunal ulceration and fistula are to be expected if patients regard postoperative recovery as the prelude to dietary excesses, bad eating habits, excessive use of tobacco and alcohol.

Once gastrojejunocolic fistula has developed the treatment is surgical for nonoperative therapy carries essentially a 100 per cent mortality. To be sure a careful preoperative medical régime is necessary to restore the depleted nutritional state, combat dehydration and increase the hemoglobin to a point at which operation can be tolerated. This involves bed rest, high caloric and high vitamin feedings of readily assimilated material, large venoclyses of fluid and electrolytes, transfusion of plasma and whole blood. Even with the best preoperative régime the operative mortality is high because poor risk patients are subjected to the double hazards of operation on the stomach and on the colon.

Choice of operative procedure must necessarily vary with the patient's general condition and the local conditions in the operative field. Excision of the fistula is a necessary part of every procedure and under ideal conditions should be combined with gastric resection at a sufficiently high level to include most of the acid bearing glands. The futility of another gastrojejunostomy without an attempt to obliterate the source of the previous jejunal ulcer should be apparent. On the other hand, excision of the fistula, separation of the gastroenteric anastomosis and restoration of the original alimentary continuity may be regarded only as a first stage to be followed after a brief interval by gastrectomy. Many patients who might be unable to survive the entire procedure at one operation would withstand the divided operation, especially if the technic of aseptic anastomosis described by Arthur Allen[1] is used in the first stage.

There are numerous reports of cases in the literature in which only the first operation, i.e., restoration of continuity, was performed, but the recurrence rate of the original duodenal ulcer is high under these circumstances. The following case illustrates the rationale of following restoration with gastrectomy:

CASE REPORT

On April 15, 1939, a fifty-two year old male was admitted to the Queen of Angels Hospital because of diarrhea, progressive weight loss despite voracious appetite, fetid breath, and regurgitation of a very foul material, all of some six months' duration.

In 1925, a posterior gastroenterostomy had been performed elsewhere for duodenal ulcer. Shortly after this operation, he began to have cramp-like pains in his left upper quadrant, not affected by dietary therapy. In 1934, an operation for abdominal adhesions had been performed without alleviation of cramps.

An examination of the patient revealed emaciation and moderate dehydration. His slightly distended abdomen was tympanitic and showed hyperactive peristalsis. A secondary anemia was partly masked by dehydration. A gastrointestinal series revealed findings suggestive of gastrojejunocolic fistula, but definite confirmation was obtained by barium enema. (Figs. 1 and 2.)

After a preliminary period of intensive preoperative preparation Tepper performed a laparotomy under spinal anesthesia. A fistulous opening was found between the jejunum and transverse colon opposite the stoma of a posterior gastroenterostomy. The fistula first was separated and repaired after which the gastrojejunostomy was dissected free and repaired. Recovery was uneventful and the patient was discharged on the fourteenth postoperative day.

He failed to co-operate for postoperative follow-up, but returned on February 25, 1941

complaining of recurrence of pain in his left upper quadrant and of marked constipation.

Physical findings at this time were noncon-

a blood transfusion, his condition improved temporarily; however, bleeding continued and despite two more transfusions his hemoglobin

A   B
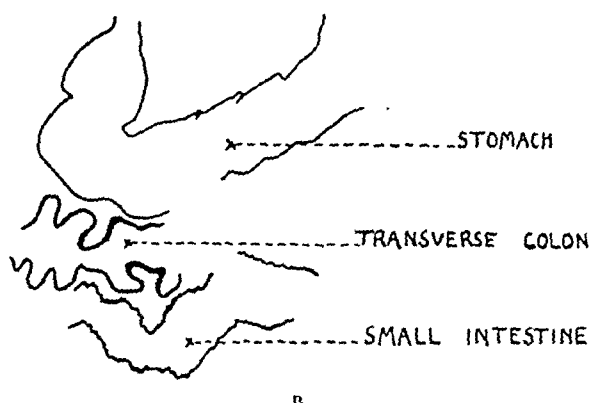
FIG. 1. A and B, gastrointestinal series fails to reveal a fistula definitely, but there is general hypermotility so that the stomach empties rapidly and barium appears almost at once in the transverse colon.

A   B
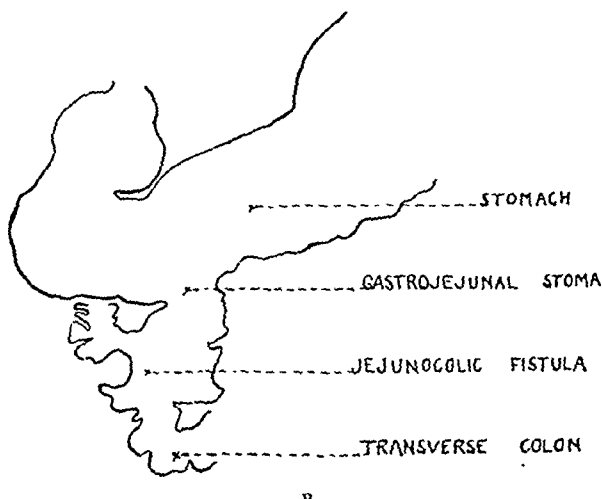
FIG. 2. A and B, barium enema; barium may be followed from the transverse colon through the fistula into the stomach by way of the gastrojejunal stoma.

tributory except for abdominal hyperperistalsis. A careful laboratory and roentgenogram examination including a gastrointestinal barium series failed to demonstrate any cause for his pain. (Fig. 3.)

On March 5, 1941, while under observation, he vomited about 600 cc. of fresh blood and went into a state of circulatory collapse. With application of appropriate therapy, including

dropped to 28 per cent, and his red cell count to below two million by March 9, 1941. Another 1,500 cc. of whole blood was given on that date and an operation was performed on the following day.

A duodenal ulcer was found which penetrated the posterior wall and had eroded into the pancreas and the pancreaticoduodenal artery. Considerable gastritis was noted. A subtotal

gastrectomy was performed with anterior Pólya anastomosis. The operation was followed by two more transfusions.

Ewald test meal on November 4, 1941, revealed complete absence of free hydrochloric acid and total gastric acidity of only sixteen degrees.
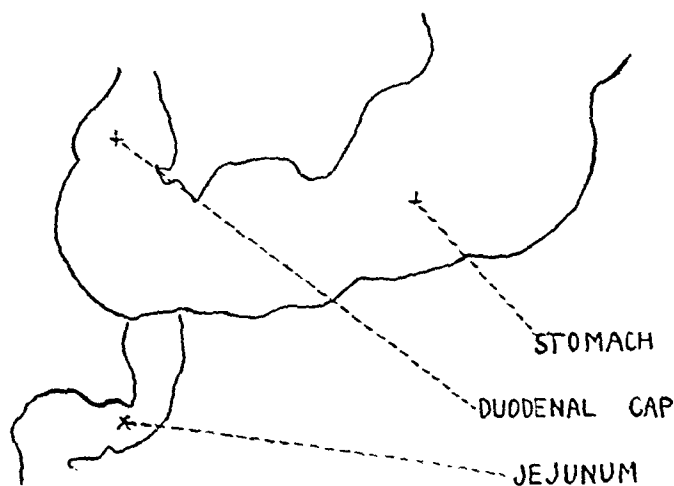
FIG. 3. A and B, gastrointestinal series after restoration of normal alimentary continuity. Duodenal cap appears normal.

FIG. 4. A and B, gastrointestinal series after gastric resection. Barium passes readily from the gastric stump through Pólya anastomosis into the jejunum.

The patient's recovery was uneventful and he was discharged on his twenty-first postoperative day. In the subsequent follow-up the patient states that he is free of abdominal pain for the first time in fifteen years. A gastroscopy on October 16, 1941, showed smooth gastric and jejunal mucosa with no evidence of gastritis or ulceration. Gastrointestinal roentgenograms on October 30, 1941, corroborated the gastroscopic findings. (Fig. 4.) An

This case illustrates the desirability of early gastrectomy after repair of gastrojejunocolic fistula. Although this patient was fifty-two years old, the original etiologic factors causing his duodenal ulcer were still present. Consequently, the recurrence of that ulcer was to have been anticipated. The only surprising aspect is the failure of the roentgenologist to find

a penetrating posterior wall ulcer of this type.

Another approach to the handling of gastrojejunocolic fistula has recently been presented by Pfeiffer.[5] He advocates establishment of a loop colostomy proximal to the fistulous opening in the colon. In his series, colostomy was followed by so much general nutritional improvement and so much improvement in the local condition that most of the patients were able to withstand adequate resection at the time of closure of the fistula.

Whether operation is performed in one stage or two, whether closure of the fistula or establishment of a colostomy is done in the first stage, the final procedure should include gastric resection. The previous existence of jejunal ulcer and fistula is evidence that anything short of this procedure is likely to be a therapeutic failure.

SUMMARY

1. Gastrojejunocolic fistula is becoming more frequent as a consequence of gastroenterostomy for peptic ulcer.

2. The symptoms and diagnosis are discussed briefly.

3. This condition may be prevented by more careful selection of operative procedure for peptic ulcer and better medical follow-up. Gastroenterostomy should be avoided in males with duodenal ulcer.

4. Treatment of the fistula requires excision and gastric resection. The operation may advantageously be divided into two stages.

5. A case report is presented.

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GALLSTONE ILEUS*

PYLORIC OBSTRUCTION CAUSED BY GALLSTONE

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GALLSTONE ileus is an uncommon condition in the experience of any one physician or surgical service. Nevertheless, it occurs often enough to be considered more frequently as a diagnostic entity and attempts should be made to reduce the high attendant mortality (50 to 60 per cent).[1,2]

Ileus, as a complication of biliary tract disease, is considered difficult or impossible of recognition by many authors.[1,2,3] It is our contention that it may be suspected with enough frequency so that early surgery will be performed to supplant the usual late ineffective surgery.

Continued publication and discussion of case reports will bring this clinical entity to the attention of physicians. The likelihood of earlier diagnosis and suitable therapy in general will be greater, and eventually the mortality will be reduced. Gallstone ileus comprises 3 to 5 per cent of all intestinal obstructions.[2,3]

This case is presented with the above mentioned reasons in mind. Two features are noteworthy: (1) the unusual size of the calculus (6½ by 4 by 4 cm.), probably one of the largest reported, (Fig. 2) and (2) the site of the obstruction, namely, the duodenum.

CASE REPORT

A white female, sixty-two years of age, was admitted to the medical service at the Coney Island hospital on October 16, 1942, with the primary complaint of persistent vomiting for the past seven days. There was no pain. There had been several previous attacks similar to this and a two-year history of gallbladder disease without jaundice. During the present illness there was marked constipation. How-ever, enemas were evocative of small amounts of fecal matter and flatus. General physical examination proved to be essentially negative. The abdomen was pendulous with slight tenderness on deep pressure in the upper right quadrant.

A provisional diagnosis of chronic cholecystitis, mild acidosis, chronic bronchitis and arteriosclerotic heart disease was made.

Routine laboratory findings revealed a positive Wassermann, and leukocytosis on October 20th of 17,000 white blood cells with 83 per cent polymorphonuclears, which was reduced by October 26th to 10,000 white blood cells with 75 per cent polymorphonuclears. Blood chemistry tests showed glucose 125 mg. per cent, urea nitrogen 12.5 mg. per cent, and creatinine 2.9 mg. per cent. Urinalysis was negative.

A flat x-ray plate of the abdomen on October 19th revealed a large calculus in the right upper quadrant apparently within the gallbladder. (Fig. 1.) The diagnosis was cholelithiasis.

The patient was kept on the medical service until October 23rd, when she was transferred to surgery. Symptoms persisted without abatement.

Repeated attempts to intubate the duodenum were unsuccessful. X-rays showed no evidence of intestinal obstruction.

On October 27th, the diagnosis of gallstone ileus was made. As soon as the patient could be properly prepared operation was performed. The stomach was greatly distended and contained a hard mass at the pylorus, which subsequently proved to be the gallstone. The gallbladder was small, contracted, cicatrized and contained neither bile nor calculi. There was a fistulous tract from the gallbladder to the duodenal gastric junction. The calculus was impacted in the duodenum and extended through the pylorus into the stomach.

In order to clarify the picture of the condition involved, the gallbladder was separated from

the stomach. This opened the gallbladder-duodenal fistula. Incision was made into the stomach and the calculus extracted. The open-

should be good, it is nevertheless poor. The problems of local gangrene or compromise of the circulation of the segment of gut

FIG. 1. X-ray demonstrating large calculus.

ing in the stomach was closed and the diseased gallbladder was removed.

The patient responded poorly to the operation, developing hyperthermia and circulatory collapse several hours afterward. In spite of supportive therapy, glucose intravenously, transfusion, and the use of oxygen, the patient expired on the first postoperative day.

REMARKS

At first it was considered that chronic cholecystitis was the cause of the persistent vomiting. Intestinal obstruction was not recognized. This is the usual time-honored error recorded in numerous reports on the subject.[3] However, if we accept the modern trend and consider acute gallbladder conditions an indication for immediate surgery, after suitable preparation, this error will not continue. Automatically, all reasons for delay in operation upon patients with gallstone ileus will vanish and early surgery will result even if the complication of ileus is not recognized.

It is ironical that where from the point of view of local disturbance, the prognosis

involved, are almost always absent. The obstruction can be readily relieved by simple enterotomy, calculus extraction and intestinal repair. However, because of the poor general condition of the patient, the operative complications and mortality are high.

If there has been a prolonged period of vomiting prior to surgery, simple relief of the obstruction without operative attention to the gallbladder must be practiced, in spite of all temptation to divide adhesions and attack the diseased gallbladder.

The presence of a cholecystoduodenal or gastric fistula is not incompatible with prolonged life in a good state of health.[2] Should there be subsequent symptoms referable to internal gallbladder fistula, further surgery can be carried out at a later date, when there is no associated problem of intestinal obstruction with the attendant derangement in blood chemistry, hemoconcentration, etc. Frequently, gallbladder intestinal fistulas will close spontaneously after the calculus has passed.[4]

The site of the obstruction is usually the terminal ileum,[2,4,7,8,9] at varying distance from the ileocecal valve, depending upon of the acute phase of the ailment, numerous attacks of colicky abdominal pain associated with persistent vomiting but incom-
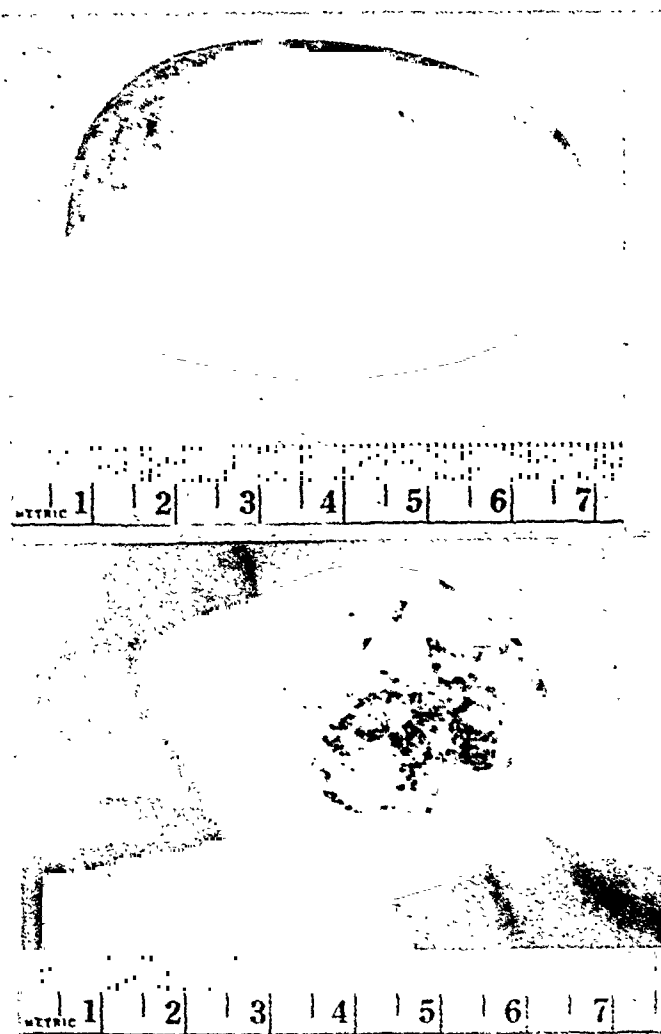
FIG. 2. Photographs of calculus.

the size of the calculus and the diameter of the intestinal lumen. One or several calculi may be present in the gut. In this case due to the exceedingly large size, the calculus was in the duodenum and extended through the pylorus into the antral portion of the stomach. The obstruction was at first classically intermittent becoming almost complete as the clinical picture developed.

After a review of many reported cases,[1-12] we believe that the symptomatology conforms with a definite pattern, though occasionally it may be difficult to recognize. There is usually a history of chronic gallbladder disease of varying duration, months to years. Then there is the onset

plete obstruction. Feces and gas continue to be passed almost until the time of operation. Association of incomplete or occasionally complete intestinal obstruction with a history of chronic gallbladder disease in an elderly individual should arouse suspicion to the presence of gallstone ileus. A flat x-ray plate of the abdomen may be of help; a large calculus may be visualized. These cases are caused by large calculi. The typical findings of small bowel obstruction may be present, that is, the dilated intestinal loop with fluid levels or visualization of valvulae conniventes. Occasionally, as a result of the gallbladder intestinal fistula, air may be seen outlining the common and hepatic

ducts or even the gallbladder. A small amount of barium given by mouth may be seen entering the biliary tract.[6]

CONCLUSION

A case of gallstone ileus is presented. The importance of this syndrome, its diagnostic features and therapy are discussed.

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A METHOD OF TREATING CYSTIC TUMORS

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MOST cystic tumors are treated by surgical removal with excellent results. But there are times when

FIG. 1. Photograph taken six months after surgery.

simple cystic tumors are so located that surgical removal presents a greater problem and greater risk as, for example, pituitary cystic tumors.

A sclerosing solution has been used in brain tumors, serous cysts of kidneys, pancreatic cysts, and simple cysts elsewhere anatomically located. I should like to present a new method of applying the sclerosing solution, with a case report.

After surgical exposure of the cyst which is difficult to remove, it is packed with one-inch gauze, impregnated with sodium

morrhuate. The end of the gauze strip is brought to the surface for drainage and easy removal, and the gauze pack left in place for three days, obtaining maximum sclerosing effect and promoting a walling off process and drainage to the outside. Then the gauze is removed, after accomplishing its purpose.

CASE REPORT

A white female, aged sixty, had a walnut-size cystic tumor mass in the middle of the neck, just below the hyoid bone, which had appeared within the past six months. She complained of sticking pain in the neck, slight difficulty in swallowing solid foods, and a foul taste in

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the mouth. A diagnosis of thyroglossol duct cyst was made from history and findings.

At operation, the cyst extended about the trachea below the hyoid bone. Due to the thin wall of the cyst, which contained a foul smelling serous oily fluid, and its investment about the trachea, we selected what we think is a new method of treating cystic tumors. We filled the cavity with one-inch gauze impregnated with 8 cc. of sodium morrhuate solution. We brought the gauze out through the skin incision and approximated the skin loosely about the drain. Hot packs were used every three hours postoperatively. On the third day the gauze was removed. The patient stated she tasted a soapy solution down in the throat.

On the fifth day the stitches were removed and approximately 5 cc. of serous fluid was removed. No more fluid accumulated and the neck healed primarily with good cosmetic results. Six months after operation there was no sign of recurrence.

In the first half of the fifteenth century several eminent physicians dealt with gynaecology. The best résumé of mediaeval gynaecology was written by Nicolò Falcucci (?–1412?) in the early part of the fifteenth century. There is a reference to a certain woman, Andrea Salsito, who lived many years after the removal of a prolapsed uterus. Falcucci likewise opened the abdominal cavity at the umbilical area and extracted foetal bones of an old abdominal pregnancy.

INTESTINAL OBSTRUCTION DUE TO GALLSTONE

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AFTER reviewing the literature, Angle[1] found that the first case of intestinal obstruction due to a gallstone was reported by Bartholin in 1654. In an analysis of 8,108 cases of intestinal obstruction, from all causes, Balch[2] discovered that 142 were due to gallstone or an incidence of 1.7 per cent, which indicates that this condition is uncommon, rather than rare. Furthermore, the vast majority of these cases, about 90 per cent, occurred in women in the later decades of life. Snyder[3] states that "the mortality attending surgical intervention in these cases, whether the specific cause of the obstruction is predetermined or not, is between 60 and 70 per cent." This makes one realize the seriousness of the problem at hand when this condition is encountered.

There are several factors which contribute to this high mortality: (1) Obesity; (2) poor operative risks because of the various generalized degenerative changes incident to old age; (3) delay in operation because of improper diagnosis. A flat plate x-ray of the abdomen should be made in all cases because the obstructing stone usually can be visualized. Rigler, Borman and Noble[4] state that in thirteen of their fourteen cases of gallstone obstruction in which roentgen examination was made, the exact diagnosis could have been made from the roentgenograms alone. (4) Improper preoperative treatment because of insufficient understanding of the pathological process at the site of obstruction. Because of the rapidity with which the impacted gallstone ulcerates through the intestinal wall, with resulting peritonitis, it is imperative that operative removal of the offending stone be done without delay. Therefore, it is very hazardous to wait for decompression by suction therapy before operating. If suction decompression is necessary for safe surgical intervention, it can be started while the patient is being prepared, and continued during and after the operation.

The treatment consists in early operation with removal of the obstructing stone. It is advisable to push the stone proximally or distally, whichever is easier, to a healthy area of the intestine for removal. If the stone is too firmly fixed for this procedure, it can usually be safely dislodged by invaginating the stone and attached bowel into the proximal and distended portion. As this is accomplished the wall of the intestine attached to the stone gradually peels off. The following three cases illustrate these points.

CASE REPORTS

CASE I. A. L., an obese female, age seventy-seven, was admitted the morning of June 5, 1936, with a diagnosis of acute abdominal condition. The night previous to admission the patient was very restless for several hours and then suffered a severe attack of generalized abdominal pain about 4 A.M. followed by nausea and vomiting. During the morning four paroxysmal attacks of severe upper abdominal pain were superimposed upon the generalized pain that had been continuous. Nausea and vomiting followed each attack.

The patient was jaundiced at the age of twenty-five for about ten days. Three years ago, she had an attack of upper abdominal pain, lasting two to three weeks, and diagnosed as gallstones.

Examination revealed an obese abdomen without distention. There was rigidity and deep tenderness just above and to the right of the umbilicus but no abnormal masses were palpable. Her temperature was 100°F., pulse 108, respiration 24, blood pressure 170/100, white blood cells 12,400. Urinalysis showed a trace of albumin. A portable flat plate of the

abdomen was not helpful. The preoperative diagnosis was intestinal obstruction.

Operation was performed two hours after

FIG. 1. Impacted gallstone removed from jejunum in Case 1.

admission. On opening the abdomen through an upper right rectus incision, a small amount of serosanguineous free fluid was encountered, culture of which was negative. The jejunum was free but completely obstructed about twelve inches from the ligament of Treitz by a hard round object in its lumen. Because of its impaction, this object was pushed proximally for several inches, using the method described above, and here removed through an incision in the wall of normal jejunum. Dense adhesions around the gallbladder were left undisturbed. The abdomen was closed without drainage. The object removed was a gallstone shown in Figure 1. Postoperative progress was very satisfactory until the ninth day when signs of cardiac failure began and progressed in spite of treatment by the medical department, resulting in death on the thirteenth day. Autopsy was refused.

CASE II. A. M., an obese female, age fifty-nine, was admitted at 5:30 P.M. December 22, 1940, with a diagnosis of acute appendicitis. About ten hours previous to admission, without any prodromal symptoms, the patient developed an attack of severe generalized abdominal pain while eating breakfast, followed immediately by vomiting. From then on to admission paroxysmal attacks of pain and nausea with some vomiting occurred, numbering about fifteen.

For the past several years she had experienced mild indigestion with belching, but without severe pain, nausea or vomiting.
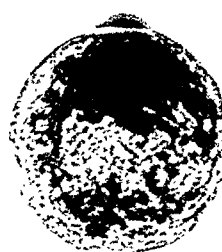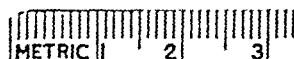
FIG. 2. Impacted gallstone removed from jejunum in Case II.

Examination revealed evidence of dehydration and an obese abdomen without distention. There was rigidity in the right upper quadrant and the point of acute tenderness was just above and to the right of the umbilicus. No abnormal masses were palpable. Her temperature was 99°F., pulse 108, respiration 24, blood pressure 130/70, hemoglobin 98 per cent, red blood cells 5,300,000, white blood cells 19,400, 84 per cent polymorphonuclears, stabs 40, seg. 44. Urinalysis showed a specific gravity of 1.018, and a moderate trace of albumin, otherwise it was negative. The impression was high intestinal obstruction.

Dehydration was combatted by parenteral fluids before, during and after operation. One hour after admission the abdomen was opened through an upper right rectus incision. Free serosanguineous fluid was present in a large amount, culture of which was negative. The jejunum was free but completely obstructed about eighteen inches from ligament of Treitz, by a firm, round object in its lumen. Three inches proximal to the point of obstruction, there was an area in the jejunum where the object must have previously been lodged, because of its bulbar dilatation, thinned wall, and three points of pressure necrosis which had not perforated. The normal appearance of the jejunal wall over the obstructing object justified the conclusion that migration distally had just occurred. Therefore, the object was removed at this point and found to be a gallstone as

shown in Figure 2. The omentum was sutured over the bulbus, necrotic area of jejunum described above. Dense adhesions about the gallbladder were left undisturbed. The patient made an uneventful postoperative recovery and was discharged on the twenty-fourth day. There has been no recurrence of symptoms.

CASE III. E. D., an obese female, age seventy-two, was admitted to medical service January 7, 1942, with a diagnosis of partial intestinal obstruction. She had been well until three days before when she developed severe pain over the entire abdomen, but chiefly at the umbilicus, associated with nausea and vomiting. These symptoms markedly improved during the twelve hours previous to admission, until she was able to retain liquids and soft foods. Her bowels had not moved for three days but an enema after admission was very effective for gas and feces. A large umbilical hernia was present for many years without symptoms.

Examination revealed no evidence of dehydration. The abdomen was obese without distention. The large umbilical hernia would completely reduce on lying down. No tenderness or rigidity and no abnormal masses were palpable. Her temperature was 98°F., pulse 74, respiration 20, blood pressure 190/90, white blood cells 8,400, normal differential and Schilling. Urinalysis showed a specific gravity of 1.028; sugar negative, a moderate trace of albumin, occasional hyaline and fine granular casts. Blood sugar was 110 mg., urea nitrogen 40, creatine 1.5. Wassermann and Kahn tests were negative.

On January 8th she was seen by one of us in consultation and a provisional diagnosis of partial intestinal obstruction related to long standing umbilical hernia was made. This was to be verified by x-ray study of the gastrointestinal tract. The evening of the following day pain, nausea and vomiting returned and the abdomen became distended. By early the next morning, January 10th, the patient had responded sufficiently to parenteral fluids and syphon suction decompression for operation. At operation a large gallstone, shown in Figure 3, was found at the ileocecal junction causing complete obstruction. The stone was pushed proximally according to the method described above and removed. Evidence of pressure necrosis was absent. There was no other evidence of obstruction. Adhesions about the

gallbladder were not disturbed and the hernia was not repaired. The abdomen was closed without drainage. The postoperative con-

FIG. 3. Impacted gallstone removed from ileocecal junction in Case III.

valescence was uneventful and the patient was discharged nineteen days later. There has been no recurrence of symptoms.

SUMMARY

1. Three cases of intestinal obstruction due to gallstones are reported.

2. All three were obese females, ages seventy-seven, fifty-nine and seventy-two years of age, respectively.

3. The exact cause of the obstruction was not diagnosed preoperatively in any case. X-ray (abdominal flat plate) was made in only one case and this was not satisfactory.

4. The site of the obstruction was high in the jejunum in two cases and at the ileocecal junction in one.

5. Pressure necrosis was present in only one case.

6. The obstructing stone, varying in size from 2 ½ to 4 cm. in diameter, was removed in all three cases.

7. Two cases recovered and have had no recurrence of symptoms. One death, age seventy-seven, was due to cardiac failure on the thirteenth day following operation.

CONCLUSIONS

1. Gallstone obstruction of the intestinal tract is uncommon but not rare.

2. Failure in diagnosis, preoperatively, may be minimized by a flat plate x-ray of the abdomen properly taken and carefully interpreted.

3. Immediate operation is the procedure of choice when the obstruction is complete in order to avoid pressure necrosis of the intestinal wall by the impacted stone.

4. The mortality is high even in the uncomplicated cases due chiefly to the usually advanced age of the patients.

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JOHANN WEYER (1515–1588), a famous demonologist, was also a capable physician and surgeon. In his *Observationum Medicarum Rararum* he reported in detail the technique for incising an imperforate hymen, and the use of lead or silver tubes to distend the vagina and maintain drainage. The incision might be either oblique, transverse or crucial.

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INTESTINAL CLAMPS*

A NEW STRUCTURAL PRINCIPLE

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MANY intestinal clamps have been described, but usually these instruments are modifications of older types of clamps and seldom include new principles either mechanical or functional. Stone,[1] in 1937, and Owings and Stone, in 1939,[2] described a clamp which incorporated a new principle: a hinged clamp closed at the open end by a second instrument.

All crushing clamps cause considerable damage not only to the tissue under the jaws of the clamp but to the bowel in the immediate vicinity of the jaws as well. The tissue under the jaws is forced laterally in both directions into the walls of the contiguous bowel. The extent of the damage done to the wall of the bowel in the immediate region where the intestinal suture is to be placed depends upon the quantity of this displaced crushed tissue.

It is not the purpose of this note to describe a new intestinal clamp, but rather to present a new principle which can be applied to many of the existing designs of gastrointestinal clamps. The principle consists merely in using beveled blades instead of blades with parallel surfaces for the jaws of the clamps (Fig. 1 A and B.) When a clamp having beveled blades crushes the wall of the bowel, the included tissue is squeezed toward the open edge of the bevel (Fig. D.) Since the clamp is applied with the approximating edges of the beveled jaws facing the region where the suture is to be placed, the tissue traumatized by the blades is forced toward the edge of the clamp against which the bowel is to be resected (Fig. 1 D and E.)

The tissue included in the jaws of the clamp (Fig. 1 B, D, and E) is desiccated with the hot cautery to form a hard, dry wedge which will not pull through the jaws of the clamp. Although the total width of the jaws of the clamp may not exceed 2.5 mm., the end of the bowel is always securely held.

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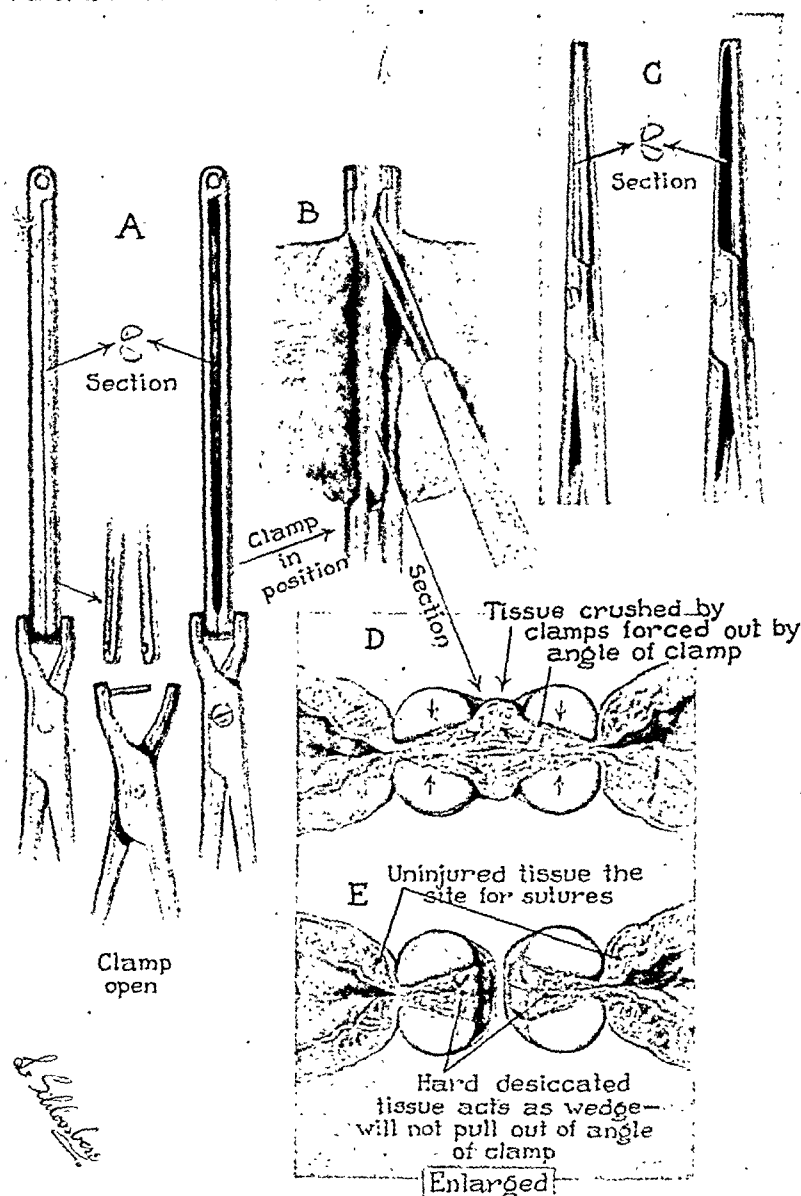
FIG. 1. A demonstration of a new principle in the design of the blades of intestinal clamps. A, illustrates the principle of the beveled blades applied to the Stone clamp. B, shows the clamps in place and resection by cautery. C, illustrates the same principle applied to a simple Kocher clamp. D, demonstrates the manner in which the tissue crushed under the blades of the clamp is forced away from the site of subsequent suture to avoid damaging this vitally important region. E, shows the narrow wedge of hard desiccated bowel included in the clamp which prevents the end of the viscus from pulling out of the instrument.

MODIFICATION OF THE RED CROSS WOODEN TRACTION SPLINT

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IN my experience teaching American Red Cross First Aid, I have come to appreciate greatly the use of the wooden traction splint.

The method of application of this splint,

stick is inserted in this last area and used as a Spanish windlass to make traction upon the ankle. (7) Several broad cravats are then applied around the leg and board from ankle to the upper thigh.
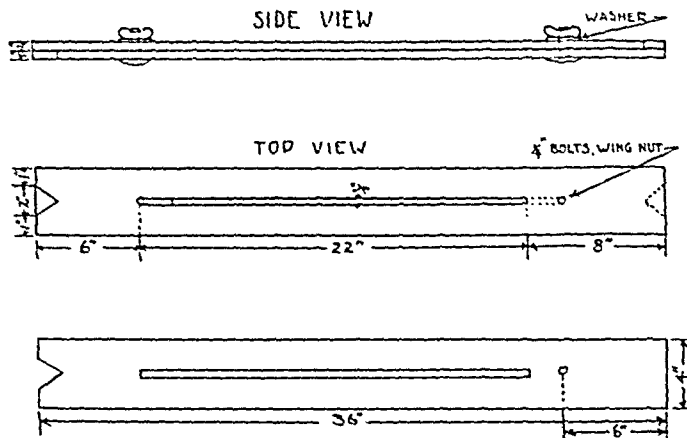
FIG. 1. Adjustable wooden traction splint.
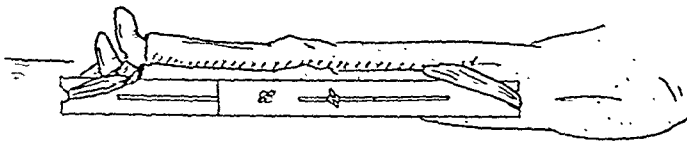
FIG. 2. Diagram of splint on lower extremity.

as outlined in the Red Cross First Aid Text Book (as applied to the lower extremity) is as follows: (1) Manual traction is applied to the foot, with countertraction on the body. (2) A cravat bandage is placed around the ankle in a traction hitch. (3) Another cravat bandage is placed with its center in the crotch of the injured leg, the ends being tied in a square knot around the upper thigh to form a loose loop above the hip. (4) One notched end of the wooden traction splint is placed against the loop of this latter cravat bandage. (5) The ends of the traction hitch on the ankle are then pulled over the notch on the other end of the splint and tied in a square knot. (6) A short

The splint consists essentially of two long flat boards, light in weight, and exactly similar in construction, with a notch at one end of each board to receive the bandage, and held together by two wing nut bolts through opposing drill holes in the boards. The size of the splint can be varied by placing the bolts in the several other drill holes in the boards.

In working with this splint, I have been impressed with the fact that a slight change in its construction would greatly facilitate its use. The modification I have to suggest is the placing of a slot in the center of each board, running to within several inches of the ends of the boards. (Fig. 1.) The bolts, anchored through drill holes in only one

of the boards, fit into the slot of the other board, so that, when the wing nut is loosened, the size of the boards can be readily adjusted. This change is made for several apparent reasons: It makes it a simple procedure to vary rapidly the size of the splint to fit any upper or lower extremity. In addition, after fitting the cravat bandages in place, the splint is applied and sufficient traction made upon the boards. The wing nuts are then rapidly tightened, maintaining this traction without any further procedure. (Fig. 2.) This method of application permits the uninterrupted manual traction of the extremity by the assistants throughout the process of the application of the splint. It also eliminates the use of the Spanish windlass for traction.

This method can rapidly be taught to first aiders. The materials necessary are readily available and are most inexpensive. Its simplicity and yet extreme effectiveness in emergency work make this modification of the splint a valuable adjunct.

A STRANGE reference to an anteverted uterus appeared in the literature of the eighteenth century. The famous French *accoucheur*, levret, in 1783, stated that the fundus of an anteverted uterus was mistaken for a bladder calculus, and the patient died from the effects of lithotomy performed because of this erroneous idea. In this instance it was stated that slight engorgement of the anterior wall of the fundus and a somewhat unusual shortening of the round liagments were considered the causes of the malposition.

The brief excerpts in this issue have been taken from "The Genealogy of Gynaecology" by James V. Ricci, M.D. (The Blakiston Company).

AUTHOR INDEX TO VOLUME LXI

SUBJECT INDEX TO VOLUME LXI

(Bo. B.) = Bookshelf Browsing; (E.) = Editorial